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THE BOTANICAL GAZETTE

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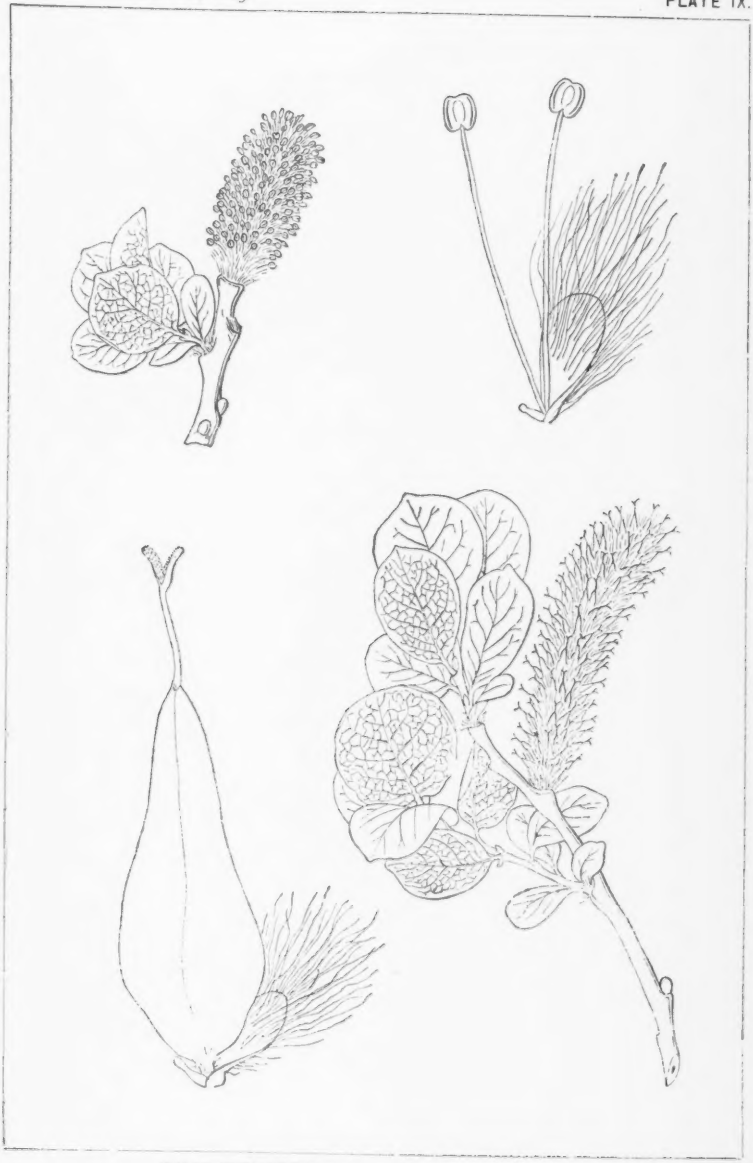


SALIX RICHARDSONII, var. MACOUNIANA BEBB.

VOL. XIV. NO. 3.—BOTANICAL GAZETTE.—MAR., 1889.

Notes on North American Willows. III.

M. S. BEBB.

(WITH PLATE IX.)

THE LANATÆ GROUP.—No more striking contribution to our knowledge of American willows was ever made than when in the Flora Boreali-Americana was published, simultaneously, three new species of this group. Of these, *Salix Richardsonii* would be recognized at the present day as a close geographical equivalent of one of the most beautiful willows of northern Europe;[1] *S. Barrattiana*, differing more widely from the European prototype, is still said to be "equal to it in beauty," with "male catkins two inches long, splendidly silky" (Hooker); while the third, *S. Hookeriana*, if apparently less showy than the other two, is more interesting and unique than either. When we consider the marked character of the species and the prominence given to their publication, each having been accorded a full plate illustration, it is strange that two of the number should remain to the present day known to science only through the old type specimens, while concerning the third, which is common on our west coast, there has since been published only Mr. Nuttall's observations, and quite recently Prof. Sargent's account of its littoral habitat and tree-like size.

Through the generous assistance of friends afield or having access to the great herbaria of the world, I am happily enabled to break the spell of obscurity which has so long hung over this interesting group. Fresh facts concerning *S. Hookeriana* have been brought together; the long lost staminate aments of *S. Richardsonii* have been found, and that, too, among Dr. Richardson's own collections; to this species a new variety is added; and, finally, I have the satisfaction to report the rediscovery of *S. Barrattiana!*

1. S. LANATA L. Eastern British America north of the Arctic circle and Greenland. (Hook. Arc. Pl.) I have not seen specimens.

[1] Wahlenberg says of S. lanata, "Est facile pulcherrima Salix in Suecia ne dicam in mundo toto."

2. S. RICHARDSONII Hook. Aments closely sessile, thick, very densely flowered; the male ovate-oblong, usually two on each twig, the terminal one larger (¾ in. thick, 1½ in. long), scales dark, rather acute, densely clothed with very long straight ashy-white or pale fulvous silky hairs; female ament terminal, oblong-cylindrical, 2–3 in. long, densely silky with cinereous hairs above and fulvous toward the base; style conspicuously elongated; stigmas linear, entire or 2-parted.

Hab. Fort Franklin on the Mackenzie River, *Richardson* v. s. in herb. Torrey. Repulse Bay, Aug. 22, 1821 (*Parry?*), herb. A. Gray. Crevices of rocks, Nachvak, Coast of Labrador, July, 1885, *Dr. Bell.*

The figure of this plant given in the Flora Boreali-Americana shows a solitary fruiting ament with nearly full-grown leaves on the same twig. This is drawn from "No. 22 Herb. H., B. & T.,"[2] but Dr. Richardson collected other specimens, both male and female, of the same species, earlier in the season, without leaves, and among these in the Torrey herbarium I am astonished to find the staminate aments which have all along been, wanting to complete our knowledge of *S. Richardsonii*. The accompanying ticket reads, "7 feet high, erect and spreading; Fort Franklin, Dr. Richardson." The impression has prevailed that the plant was of more humble stature. Andersson says "*frutex parvus*"—probably a mere conjecture, since no mention is made of the height by Hooker. Indeed, as these earlier specimens *are not numbered* I imagine none like them were sent abroad, and hence the incompleteness of the original figure and description and also the omission of Dr. Richardson's field note as to stature.

Var. MACOUNIANA. Leaves orbicular, the earliest obovate, quite entire, less than one inch long and broad, covered when young with floccose hairs, especially on the upper surface, soon smooth, dark green and somewhat shining above, paler and reticulate-veined beneath; aments small for the group, whitish-silky with just a shade of fulvous in the male, scales obtuse, stigmas entire, otherwise as in the type.

[2] Hooker, Barratt and Torrey, I take it. The willows collected by Richardson, Douglas, Drummond and others were placed in Dr. Barratt's hands to be studied and arranged. He seems to have distributed the specimens into three sets, under corresponding numbers. The most complete set doubtless went to Hooker. The one in the Torrey herbarium is in some respects quite satisfactory, then again provokingly deficient. If Dr. Barratt retained a full set for himself, scarcely a trace of it remained at the time his herbarium came into the possession of Middletown College, so I am informed by Prof. Rice. I am indebted to my friend Dr. Britton for an opportunity to re-examine the interesting old types which fortunately fell to the safe keeping of Dr. Torrey.

South Twin, James Bay. Collected July 17, 1887, by Mr. James M. Macoun, for whom it is named.

"A small, compact bush, 2 to 4 feet high, with just the habit of a garden currant, growing in peaty soil by a small pond in company with *S. arctica*." This association, taken in connection with the resemblance which the leaves bear to certain Canadian forms of *S. arctica*, might suggest the question whether our plant was due to a cross with that species, but the aments do not show a trace of any such admixture. Had it not been for the intermediate character of the Labrador specimens I should have taken this for an extreme modification, either of *S. Richardsonii*, or of the Greenland *S. lanata*, deserving to rank as a good species. Its occurrence on the level of the plain in lat. 53° 20′, further south than any form of either species mentioned has ever been found before, is in keeping with the essentially arctic vegetation by which it is accompanied and the physical conditions described by Mr. Macoun in his interesting "Notes on the Flora of James Bay" (BOT. GAZETTE, xiii. 113).

Plate IX. *S. Richardsonii* Hook., var. *Macouniana* Bebb. Capsule and stamens ×6.

3. S. BARRATTIANA Hook. Alpine swamps in the Rocky Mts., *Drummond!* In thickets at high elevations, Kicking-Horse Lake, *Prof. John Macoun!*

When a species of pronounced character is founded upon a single collection and remains thenceforth for more than half a century known to science only through the type specimens, it is interesting to compare the rediscovered plant with the original description and note in how far, if at all, it may be necessary to modify the characters at first assigned. In Prof. Macoun's specimens, the full-grown leaves, 2½ inches long by ¾ inch broad, are elliptic-oblanceolate, pointed at both ends, not at all "blunt and cordate at the base," but with this exception the agreement throughout with the excellent description given by Hooker is perfect, even to the "*stipulis glabriusculis*." This character, omitted by Andersson, would appear to be constant. It presents certainly a striking peculiarity, the like of which I have not observed in any other willow. Set upon a hirsute stem, at the base of silky-pubescent leaves, and thus in marked contrast with the surfaces on either side, we find the stipules yellowish-green and glabrate! The styles and stigmas are reddish-brown. The dark-brown twigs, "marked with the scars of former years' leaves," are rendered still more shaggy in appearance by

the old, blackened, still clinging stipules. The capsules are rather larger than in the type specimens, with the same bifid stigmas; scale narrower.

I can not imagine why Prof. Andersson went out of his way to give as the habitat of this species, "Near Fort Franklin, subarctic America, Richardson, Douglas," for Richardson never collected *S. Barrattiana* anywhere. Douglas never collected anything at Fort Franklin, and finally the credit belonged exclusively to a third person, not mentioned at all, who found the plant in an entirely different locality, a locality confirmed by Macoun's rediscovery.

4. S. Hookeriana Barratt. This, as observed by Prof. Sargent, is a small tree 20 to 30 feet in height, with a trunk rarely 12 to 18 inches in diameter, "more often a low straggling shrub with many prostrate stems: on the coast generally along the edge of sea beaches, or in low, rather moist sandy soil." Mr. Howell's experience of the general habit of the species is: "a small tree or large shrub, 10 to 20, or rarely even 30 feet in height, with usually several stems from the same root 4 to 8 inches or more in diameter. It is a plant of the sea coast and salt marshes, usually growing on the margin of ponds, but confined in its range to the immediate proximity of the sea. Very abundant about the mouth of the Columbia, and perhaps the commonest willow of the coast from Port Oxford, near the south line of Oregon, north to Vancouver Island. I have never found it away from the direct influence of the sea. Mr. Nuttall's locality, 'outlet of the Wahlamet,' must be a slip of the pen for outlet of the Oregon (Columbia). I live at the mouth of the Willamette, within a few miles of Wyeth's old station, where Nuttall made his headquarters, and I know that no such tree grows here. I am quite satisfied in my own mind that *S. Hookerania* does not occur inland, though it might possibly be found near a saline spring."

Dr. Barratt describes the capsules as "glaberrimis," and this is emphasized by Hooker's remark, "pistil perfectly glabrous, even its stipe;" but while true of the type specimens (the capsules of which are past maturity), I find that more frequently the capsules, especially when young, are silky. This is quite noticeable in a form collected by Prof. Macoun on Vancouver Island, and goes to confirm the seeming affinity with *S. Barrattiana*. Furthermore, mixed with the type specimens of *S. Barrattiana*, coll. *Douglas*, are pistillate aments without leaves, but showing shorter stigmas *invaria-*

bly entire, shorter style and longer pedicel—a manifest variation in the direction of *S. Hookeriana*. We are thus led to recognize as between *S. Hookeriana* of the Pacific coast and *S. Barrattiana* of the Rocky Mountains a relationship similar to that which prevails as between *S. lasiolepis* and *S. irrorata*, *S. lasiandra* and *S. Fendleriana*, *S. Scouleriana* and *S. flavescens*, only that both in habitat and character the difference is more pronounced, for in no one of the parallel cases mentioned is the coast plant confined to the immediate sea shore.

In the Flora Boreali-Americana two widely sundered localities are given for this species, viz.; "Grand Rapids of the Saskatchawan, *Douglas*. N. W. coast of America, *Scouler*." Writing while all the facts were fresh, Hooker seems to have known that the plant had been collected by Scouler on the N. W. coast, but there are no specimens credited to Scouler in the Hookerian herbarium. "There is only one sheet of *S. Hookeriana*, and on it are the analyses which indicatethat from this the plate in the Flora Boreali-Americana was drawn. To it is attached a label in the handwriting of Douglas, 'Near the Grand Rapids of the Saskatchawan, rare—a scrubby, low shrub'" (Baker). The plant figured is identical with that now so well known from all along our northwestern coast. I believe the specimens were collected by Scouler, and that the Douglas ticket, carrying with it the Saskatchawan habitat, was misplaced by Dr. Barratt. The very wording of the ticket, "A scrubby low bush," is inconsistent with the distant nodes and smooth vigorous shoots of the figure; but, above all, it is incredible that a tree which by the concurrent testimony of all recent observers is known only as growing on the beach or around the brackish ponds of the Pacific coast, should, "once upon a time," half a century ago, have been found east of all the Rockies and thenceforth escape detection by all subsequent explorers. Beyond this negative evidence, which could scarcely be stronger than it is, there lies another consideration not to be lost sight of. When two species, representative each of the other, are found occupying areas separated by physical features which would appear sufficient to cut off all interchange, one becoming modified by and restricted to a humid coast environment, the other modified by and restricted to a high mountain environment, it is absurd to expect that one will be found invading the area of the other and preserving intact its specific identity.

For my own part, I know too well how prone Dr. Bar-

ratt was to be just a bit careless, to say the least, in arranging loose material, to believe implicitly that the Douglas ticket was rightly placed, against such cumulative evidence to the contrary.

Rockford, Ill.

Intracellular Pangenesis.

DR. J. W. MOLL.

This is the title of a book by Prof. Hugo de Vries, which has just appeared in the German language,[1] and will no doubt create considerable interest. The subject with which it deals is one of the highest importance, and of the manner in which it has been treated I will try to give a short account.

By many investigators of organized nature, and especially by those who have studied the phenomena of heredity, the necessity has been felt of assuming that hereditary characters in animals and plants are the visible effects produced by the nature of those substances which constitute living organisms. Hence many speculations have arisen about the structure which these substances may possess, and about the manner of their dispersion through the living body. However hopeless such attempts to penetrate into one of the greatest mysteries of nature may at first sight appear, some light certainly has been thrown on this matter through the exertions of several distinguished naturalists.

Among these Charles Darwin, without doubt, ought to be named in the very first place, and the chief object of this book is to induce in its readers a more just and higher appreciation of one of the most fertile conceptions of this illustrious author.

But others have studied the same subject, and of these the principal are Herbert Spencer, Haeckel, Nägeli, and Weismann. A comparative and critical consideration of the different views to which the above named authors have been led is the subject of the first part of Prof. de Vries's book.

In the first place, he ably shows that Darwin's so-called provisional hypothesis of pangenesis[2] essentially consists of two well defined and in many respects independent parts:

1. All hereditary characters of an organism are repre-

[1] Jena, Gustav Fischer, 1889.

[2] The Variation of Animals and Plants under Domestication. Vol. ii. p. 349.

sented by separate particles of living matter. Of these there are as many kinds as there are characters, and Darwin has called them "gemmules." Their principal attributes are that they are capable of growth and reproduce themselves, and that they can remain latent for a long time, even during many generations. In this case the hereditary characters with which they correspond do not become visible, but after a certain time they may reappear. When cell-division takes place, the gemmules are equally divided in the two nascent cells, and this is one mode of migration, by which the several organs and tissues of the body acquire their hereditary characters.

2. There is still another mode of migration, as it is assumed that every separate part of the whole organization throws off its gemmules, which are dispersed throughout the whole system, and are collected from all parts to constitute the sexual elements and buds, from which new beings are developed.

The second position was much insisted upon by Darwin, as he thought this assumption necessary to explain the hereditary effects of use and disuse, the occurrence of graft-hybrids, and the direct action of the male element on the female.

Our views upon this part of the subject have been much changed since Weismann[3] has shown that those cases in which characters, seemingly acquired in later life, are transmitted to the offspring, do not necessarily prove a transmission of these characters from the altered organs to the germ which will become a new individual. They can be explained as well by assuming that the peculiar structure of the germ, from which the first varying individual sprung, caused the subsequent variations also, and that they were thus transmitted from germ to germ.

Hence there remain only a few, seldom occurring cases, which seem to be inexplicable, if migration of gemmules is not conceded. But as some of these cases can be explained otherwise, and all stand in need of further investigation, there are now no sufficient reasons to support the theory that gemmules migrate from all parts of the organism in order to unite in some other parts.

Those authors, however, who are opposed to the migration theory, have mostly thought that with it the whole hypothesis of pangenesis fell. But this, obviously, is a grave error, as the first and essential supposition of the hypothesis remains unshaken by these arguments.

[3] Ueber die Vererbung, 1883.

On the single assumption that there exist "gemmules," in Darwin's sense of the word, and that these are transmitted by cell-division through all parts of the system, it still remains possible "to connect under one point of view several grand classes of facts," of which the principal are: all forms of asexual and sexual reproduction, heredity, variability, reversion, regrowth of amputated parts, and development of organisms in all its forms, whether normal or abnormal.

Darwin's pangenesis, notwithstanding its usefulness and simplicity, has been exposed to many misunderstandings, and this may partly be attributed to the great stress laid by its author upon the migration of gemmules; partly also to the fact that the term "gemmules" itself was not happily chosen. It has certainly been misinterpreted by some authors in the most unaccountable manner, and as, moreover, the idea of wandering particles is closely connected with it, de Vries does not use this term. The particles, to which the development of hereditary characters is due and which, according to his view, do not migrate through the whole organism, are called by him "pangens" (Pangene). Though this word, as well as that of pangenesis itself, will, without doubt make the hairs of a strictly grammatical reader stand on end, we will adopt it without scruple, because it is short and expressive. Moreover, its illegitimate origin will guard it against being misunderstood, as the term gemmules was.

Besides Darwin, as I have already observed, others have at one time and another tried to solve the same problem, and we will follow de Vries in his discussion of these several hypotheses.

That of Elsberg-Haeckel is especially characterized by the view that the material basis of heredity is to be sought for in the chemical molecules which constitute living protoplasm. Now it is certain that in the end the laws of heredity will be explained by the molecular phenomena of living beings. But as yet we are still very far from this point, and we are forced to assume that the particles of substance to which the appearance of hereditary characters is due, are capable of assimilating food, of growing and of reproducing themselves. There is no theory in existence which can explain from a purely chemical point of view, and merely by making use of the known properties of chemical molecules, these wonderful phenomena. Thus we are led to believe that if hereditary characters are bound to certain substances, the molecules of these substances are united into particles of

a much higher order, and approaching in their complexity of structure, power of growth, and self-division, the lowest organisms themselves. This has already been pointed out by Darwin, and if this be conceded, it obviously follows that these particles are not identical with chemical molecules in the proper sense of the word. The truth of this has perhaps in some measure been felt by Elsberg and Haeckel when they gave to the molecules, which represent hereditary characters, the distinctive name of "plastidules."

Some other authors, in particular Spencer and Weismann, have avoided this fault, but they do not assume, with Darwin, that every separate hereditary character of each organism is represented by a separate kind of living particles. They, on the contrary, suppose that the living matter from which an organism is developed consists of indivisible particles, each representing all hereditary characters of the species to which it belongs. It is certainly of much importance that de Vries has clearly pointed out the existence of this difference, as it will lead to a better understanding.

Spencer has called these particles "physiological units;" Weismann has given them the name of "ancestral plasmata" (Ahnen-plasmen), and he has applied his views to the more recent discoveries in cellular morphology. He is of opinion that the ancestral plasmata have their seat in the nucleus of the cell.

Though in many respects differing from the foregoing hypotheses, still Nägeli's "idioplasma" also represents all characters of the species.

This is a common feature of all these hypotheses, and their most important distinction from Darwin's pangenesis, as here it is assumed that every organism contains multitudes of different pangens, each representing a separate hereditary character, or as Darwin himself has expressed it: "an organic being is a microcosm—a little universe, formed of a host of self-propagating organisms, inconceivably minute and numerous as the stars in heaven."

The question, which of these opposed views is nearest to the truth, is amply discussed by the author, and almost the whole first part of the book is devoted to it.

First it is shown that the different and numerous hereditary characters which a species displays are in many respects independent of each other. To those who believe in the origin of species by means of natural selection, it is obvious

that the several characters, now constituting together a certain species, can not have appeared all at once, but were gained step by step, in many instances, without doubt, one by one.

The same characters often occur in many widely different species, *e. g.* the power of forming chlorophyll, tannin and many other substances, the peculiar habits of climbing and insectivorous plants, etc. All these are essentially the same in different plants, often belonging to separate families and orders.

It also often occurs that a single character, for instance hairiness or a certain coloring matter, is missing in a species, which otherwise exhibits in all its parts the same characters as other species of the same genus.

The differences between several species, and those between the several organs of a single animal or plant, are quite of the same order. This is conclusively shown by those cases in which secondary sexual characters or the different forms occurring in alternate generation furnished a foundation for many species, now recognized as the male, female or asexual forms of other species.

In many instances, also, simple bud-variations in plants have been developed by the art of man into new varieties of plants. And, lastly, it is generally known that the same peculiarities, for instance a red cell-sap, may be characteristic as well for certain species of a genus as for certain organs of a single individual.

Nobody will dispute the fact that many hereditary characters can be altered, or even can disappear, in some individuals, without other characters of the species in the same individual being in the least degree affected. An individual plant may have no hairs, or exhibit a changed color, all its other characters remaining the same as those of its parents; though it must be borne in mind that often little groups of characters are known to vary together. Breeders of animals and plants daily make use of such occurrences for improving their breed, and probably the scientific investigation of such cases will throw much light upon the nature of hereditary characters.

The cases of reversion, for instance that of stripes in horses and asses, show that often characters which belonged to far progenitors may suddenly reappear and combine with other characters which remain unaltered.

Another important fact is this, that hereditary characters

may be blended together in the same individual, even if they originally belonged to different species. This is most clearly shown by the occurrence of hybrids, which generally hold an intermediate place between the father and mother. But even in this case the characters retain their independence, as is clearly shown when these hybrids are fertile *inter se*. For in the subsequent generation generally some individuals wholly revert to the shape of their grandmother, others to that of their grandfather, and all intermediate gradations may be observed. In normal sexual reproduction in general the same rules prevail. All the foregoing facts, of which I am only able to give a brief summary, point to the conclusion that every character is bound to its own kind of material particles, and that these are in many respects independent of each other. On the other hand, it will be very difficult, if not impossible, to reconcile with these facts the view that in living beings all hereditary characters of the species are represented together by one and the same kind of indivisible particles. At all events this view is a wholly superfluous auxiliary hypothesis.

But there is more. When the different organs of the body are formed and developed, the characters of these organs gradually appear, and thus some parts become different from others. In pangenesis this offers no difficulty, as it is not inconceivable that some pangens are developed in one, some in another part of the body. But if the opposite assumption is made, we here meet with many obstacles. This subject has been discussed by Weismann, and he has been forced to the supposition that there are two strictly separate kinds of protoplasm, one of which he has called "germ-plasma" (Keimplasma), the other "somatic plasma" (somatisches Plasma). The first of these consists of his "ancestral plasmata," and can reproduce the whole organism. Somatic plasma is developed from germ-plasma, when the vegetative organs of the body appear. It is less complex in structure, and contains only those characters which are needful for the parts to be formed.

In the higher orders of animals it may seem in some degree possible that two such kinds of protoplasm should exist, but every botanist will grant that in plants there is an overwhelming evidence against the supposition that the protoplasts of leaves and roots are widely different from those of spores and seeds. Many are the cases in which well-defined vegetative organs and even all cells of highly complex plants

can form the basis of a new being. The productions of gall-insects show in the same manner that in every part of a plant many hereditary characters lie hidden, which will only appear if a proper stimulant is applied. Thus the hypothesis of germ- and somatic-plasma, though it may have a logical foundation in Weismann's assumption of ancestral plasmata, is not at all supported by the facts observed in nature. And from this point of view it certainly is a great advantage that pangenesis has nothing whatever to do with such a secondary hypothesis.

Lastly, Spencer and Weismann both admit that when sexual propagation takes place, the physiological units or ancestral plasmata of father and mother are both to be found in the offspring. And this would lead to the assumption that in every organism all its ancestors from the beginning of organic life till the present day are represented. Both naturalists have felt the absurdity of such a proposition, and both are compelled to a new auxiliary hypothesis; Spencer supposing that diss milar physiological units, when mixed together, tend to segregate, and Weismann taking for granted that each time, before a sexual union takes place, one-half of the ancestral plasmata are first removed, so that their number remains constant. This removal, according to Weismann, takes place when the second polar-globule is expelled from the ovum.

Pangenesis, again, has no need whatever of such an assumption, as no reason can be given why an excessive number of different pangens should associate.

From all these considerations it may be concluded with safety that pangenesis, combining all advantages of its sister-hypotheses, greatly excels them, so that it has no need of any auxiliary hypothesis whatever.

It is, moreover, much more simple in its application. Apparently this is not the case, as pangenesis assumes the existence of great numbers of different pangens in every being, whilst of ancestral plasmata or physiological units one kind suffices for the formation of the most complex organism. If, however, not a single being, but all organisms which the world contains are considered, the case is entirely reversed. Then it must be conceded that one is compelled to assume as many different kinds of physiological units or ancestral plasmata as there are and ever have been species in the world. In pangenesis, however, a relatively small number of different pangens will suffice to form by its numberless combina-

tions and permutations all living and extinct organized creatures.

It is a curious fact that Darwin himself has not laid much stress on the peculiarity of his gemmules as not representing each the whole organism, but only a single or a few hereditary characters. But he thought that this proposition was evident to all those who had studied the subject. He even thought, for a time, that his views were materially the same with those of Spencer, who wrote some years before him, although he afterwards saw that this was not the case.

Perhaps to this circumstance, also, it may be partly attributed that the hypothesis of pangenesis has as yet found few adherents among leading naturalists. But now this obstacle has been removed. The name of gemmules, which caused so many misunderstandings, is replaced by another. Last, but not least, Prof. de Vries has clearly shown that on no other known assumption can many important classes of facts be connected together so well as on that which forms the basis of pangenesis. I have no doubt that for this hypothesis a new era begins with the publication of this book.

In the second part of his book the author deals with the more recent discoveries in cellular morphology. He shows that the hypothesis of pangenesis, as set forth in the first part, is in perfect accordance with what has been brought to light for the most part long after Darwin had written his hypothesis. It is only natural that in applying it to the microscopical structure of cells some questions arise. These have been answered by the author, and thus some additional propositions are made, which, together with the original hypothesis, constitute what the author has called "intracellular pangenesis."

This second part of the book is much longer than the first, but it is impossible, in so short a compass as is allowed here, to mention many details, which are, however, necessary for fairly reproducing it. I must be content with giving only some faint outlines, which perhaps will induce the reader to peruse the book itself.

In the first place, it must be remembered that Prof. de Vries, in one of his former publications,[4] has explained his views on the structure of the protoplasmic body of vegetable cells. With Hanstein, he considers the protoplasmic contents of every cell as an individual, and, with this author, he gives to it the name of "protoplast." He is opposed to

[4] Plasmolytische Studien. Pringsh. Jahrb. xvi. p. 489.

those who consider the protoplasm as a gelatinous mass, in which here and there some bodies, such as a nucleus and plastids, are imbedded, and he calls the protoplast an elementary organism, composed of several organs, which stand in some respects in the same relation to each other as the organs of a multicellular plant. There is, however, one peculiarity in the organization of the protoplast, which is that its organs always derive their origin from similar organs. As far as is now known, they never appear in a protoplast which has not received them from its ancestors, and if a protoplast afterwards contains more organs of the same sort than it did when young, these are formed by repeated divisions. It may be said, with perfect truth, that the organization of protoplasts is a visibly hereditary one.

These views, of which I can only give a very short account, are discussed here in detail, as recent discoveries, partially made under the auspices of Prof. de Vries himself, have contributed much to confirm them. As for the nucleus, it is now generally known that this must be a very important organ, that it propagates itself by division, and never appears except where this has taken place. The same has been proved for plastids by Schmitz, Schimper and Arthur Meyer.

By Prof. de Vries himself it has been shown that vacuoles have a wall of living protoplasm, which can easily be separated from the other parts of the protoplast. He has called this wall "tonoplast," and has conclusively shown that it must be considered also as a separate organ, in all probability for producing cell-sap. Now the question remained, whence did the protoplast derive its tonoplasts and vacuoles, and this has been solved by Went, who has found that all vegetable cells, even the very youngest, contain vacuoles: that they can divide themselves or be divided, and thus multiply; and that in those cases in which formerly the appearance of vacuoles in homogeneous protoplasm was assumed, they are already present, but have been hitherto overlooked.

Another of Prof. de Vries's pupils, Wakker, has found that the so-called aleurone-grains are nothing else than the dried up albuminous contents of vacuoles in seeds, and that crystals in living cells are formed within the vacuoles.

Thus the whole protoplast appears as an organized individual, with its nucleus, plastids (which in many cases form starch), and tonoplasts (always containing cell-sap, often crystals or aleurone-grains). In the remaining part of the

protoplast a homogeneous superficial layer, which probably produces the cell-wall, can be distinguished from the inner granular mass, which is almost always in motion. It is in accordance with the author's views to see in these two parts, also, peculiar organs of the protoplast, and to suppose that the one can not be formed out of the other. He elaborately shows that, for the present, there are no facts proving such a transition, and that this subject deserves being thoroughly investigated.

At all events there is ample evidence to prove that the protoplast is an elementary organism, possessed of an hereditary organization. When cell division takes place, each daughter-cell receives its several organs as such from its parent cell, and there are no cases on record in which these organs have been independently formed from a homogeneous protoplasmic mass.

This conception of cell-division is called by the author the "panmeristic" view, in opposition to the old "neogenetic" view, which supposed that the organs of the protoplast could be newly formed after the cell is divided. As far as nucleus and plastids are concerned the neogenetic view has already been abandoned by most authors.

In the second place, the progress in our knowledge of the process of fecundation is amply discussed. It is shown that, according to the latest discoveries, it is the union of two nuclei which chiefly characterizes this process.

In the conjugation of algæ only the nuclei penetrate each other. The same is the case when a properly so-called fecundation takes place, in spermatozoa and pollen-grains the nucleus only penetrating into the ovum and uniting with its nucleus.

From these facts it appears that after fecundation in the higher organized plants the germ-cell, in truth, only contains a fecundated nucleus, whilst all other hereditary organs of its protoplast are derived only from the mother-plant.

The author applies these several facts and views to the hypothesis of pangenesis. In explaining this we will, for convenience, suppose that the pollen of one species fecundates the ovum of another allied species, and that in this manner a hybrid is formed which, as usual, in all its characersis midway between the parent plants. Common sexual reproduction is essentially the same process, and therefore the conclusions to which we come in this manner are applicable to all other cases.

As a single nucleus has sufficed for fecundation, it is clear that, on the basis of pangenesis, this must have contained pangens, representing all hereditary characters belonging to the father-plant. But all organs of the hybrid are hybridized (plastids, vacuoles, etc.), and hence it follows that the hybrid nucleus can influence in some manner all other organs of its protoplast, and thus all hereditary characters of the species.

Now the question remains, how it is possible that the nucleus exercises such an influence. Various answers can be given. Some authors maintain that a certain dynamic influence is transmitted from the nucleus to all other parts of the living protoplast; others propose the doctrine that certain enzymatic substances emanate from the nucleus and can produce changes in the surrounding protoplasm. On both these suppositions (and if it be conceded that the nucleus contains all sorts of pangens) it must be assumed that in all other organs of the protoplast there are peculiar substances, capable of growth and propagation, and producing through the dynamic or enzymatic influence from the nucleus those visible effects of which the pangens are the representatives. For, as has been shown, tonoplasts, plastids, etc., can propagate their kind, and it is through the activity of these organs of the protoplasts that hereditary characters become manifest. It is obvious that here is a secondary hypothesis of which there is no need. For if it is assumed, with Darwin, that not only the nucleus, but all other organs of the protoplast, in short living protoplasm in the widest sense of the word, consists of pangens, and of these only, the hypothesis of two kinds of self-propagating particles, corresponding with hereditary characters, becomes gratuitous. And at the same time, the supposition of a dynamic or enzymatic influence, issuing from the nucleus, can on this view be dismissed, whilst in its place comes the much simpler suggestion that pangens can migrate from the nucleus to all other organs of the same protoplast, of which it forms the center.

Our present views on the origin of species independently lead to the same conclusion, as it is clear that in the first organisms without nucleus, pangens were diffused throughout the whole protoplast, and were afterwards combined in one body when a nucleus made its appearance.

The hypothesis, explained in the foregoing lines, is called by Prof. de Vries that of "intracellular pangenesis." Giv-

ing a brief recapitulation, it can be said to consist of the following assumptions: The nucleus of every cell, used in propagation, contains all sorts of pangens of the species of animal or plant to which it belongs. As all other nuclei of the full-grown being owe their origin to repeated divisions of the first one, they all can be in possession of a complete set of pangens, which can propagate themselves when a division takes place. In the nucleus the greatest part of them remain inactive through life, with the exception only of those pangens which determine the visible characters of the nucleus itself, such as its peculiar mode of division, etc.

All other organs of the protoplast essentially contain only pangens corresponding to the characters which they are capable of displaying. It is, however, by no means necessary that they all are at all times in an active state, as, for instance, plastids in some cases are known to exhibit alternately their power of forming starch and that of forming colored matter. But, no doubt, at most times these organs contain a large amount of active pangens.

Inactive pangens from the nucleus can migrate to those other organs of the protoplast, whose characters they represent; they can again propagate themselves here, and in most cases sooner or later become active, thus bringing to light certain characters.

This migration, as shown by the facts of sexual reproduction, must occur soon after fecundation has taken place, but there is no reason why it could not happen in many other phases of development, perhaps even every time a cell-division is achieved. The author is of opinion that the migration of pangens from the nucleus to other parts of the protoplast may be effected by the movements of protoplasm, to which view there is the less objection as it has been lately shown that these movements are by no means wanting, even in the very youngest vegetable cells.

From the foregoing review it is obvious that on the assumption of intracellular pangenesis the possibility of pangens migrating from one part of the body into other parts is not at all excluded. This will be readily assented to if it is recollected that of late years many facts have been accumulated proving that the protoplasts of neighboring cells are connected together by fine protoplasmic filaments passing through the cell-walls. Moreover, Prof. de Vries himself has rendered it highly probable that the movements of pro-

toplasm are the means by which alimentary and other substances are transported through the vegetable body.

But it must be borne in mind that if the possibility of a migration of pangens from cell to cell be conceded from an anatomical point of view, this by no means suffices for the assumption that it actually does take place. And as Weismann has shown that there are no facts in heredity imperatively requiring such an explanation, a migration of pangens through the whole body is excluded from the hypothesis of intracellular pangenesis.

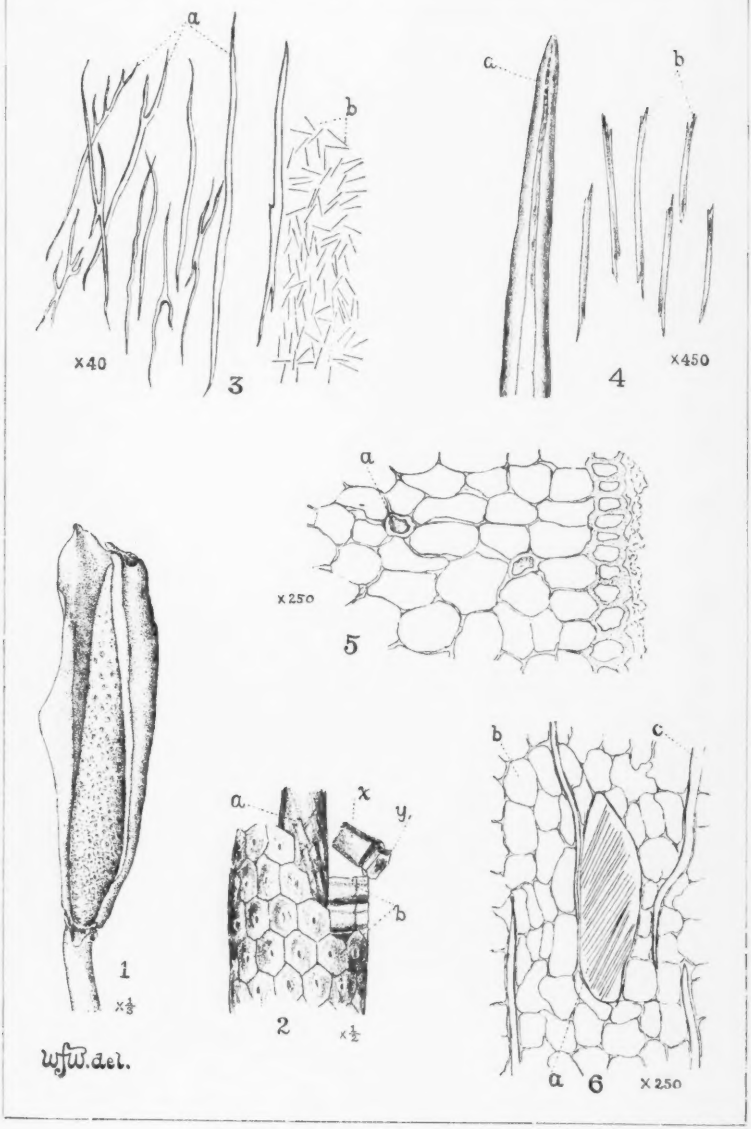
Moreover, in confining the migration of pangens within the limits of a single protoplast, there is only assumed that inactive pangens can leave the nucleus and sooner or later become active in other parts of the protoplast. But if the assumption of free migration through the whole body shall have any connection with the facts of heredity, a further hypothesis is necessary, viz.: that pangens, coming from all parts, are able to enter into the nuclei of those cells, which will serve for propagation. But, as has been shown, this hypothesis can be dispensed with.

It would, of course, be a delusive fancy to think that on so complex a subject as that which has been so ably treated by Prof. de Vries, the greater part of scientific men will at once, or even at a not very distant period, become of the same mind; and he himself is probably well aware that some of his propositions will be vigorously attacked. Moreover, he has chiefly treated his subject from a botanical point of view, and in a few cases, perhaps, there will be some difficulty in applying his hypothesis to the animal organism. But there is a great probability that such difficulties will not prove to be permanent ones.

At all events, even those most opposed to his views will be forced to acknowledge that intracellular pangenesis has been expounded by one who has fully mastered his subject, and that it certainly deserves to be carefully considered in all its parts, be the conclusion to which such consideration leads what it may.

It is from this conviction that I have not thought it useless to give a short account of Prof. de Vries's book to the readers of this journal.

Utrecht, Holland.



WINDLE on FRUIT OF MONSTERA.

Fibres and raphides in fruit of Monstera.

W. S. WINDLE.

(WITH PLATE X.)

Monstera deliciosa is a native of Central and South America, belonging to the Aroideæ, and closely related to the Calla. It possesses a weak, elongated, stoloniferous stem, by which it clings to rough walls, or rocks, or firmly clutches some tree by means of its numerous adventitious roots, reaching sometimes 10 to 50 feet in length or more. Its large, wide-spreading leaves, borne upon long petioles, are perforated by large elongated openings. The cylindrical fruit is an aggregate, termed by Dr. Masters a berry or sarcocarp. It is borne erect upon a long, rounded peduncle among the upper leaves of the plant, and when young is sheathed by a hood-like deciduous spathe. The fruit when mature is about 20 cm. in length by 4 cm. in diameter. Running through its center is a thick core (endocarp), surrounding which is the pulpy, edible portion. This latter part is composed of small, elongated, hexagonal segments placed side by side. Each is made up of a thick inner part (mesocarp), and of a thinner outer part (exocarp). These separate from each other in the ripened fruit. The mesocarp is the true edible portion of the fruit, and is considered by many as a great delicacy because of its pleasant characteristic flavor, slightly resembling that of the pine-apple. But the outer part of the fruit, the exocarp, is always judiciously discarded, on account of the sharp, stinging sensation produced upon the tongue and palate when it is taken into the mouth, an effect similar to that caused by weak acids.

By placing a minute part of this exocarp under the microscope, the cause of this peculiar action is at once shown. Groups of slender, sharp-pointed, needle-like cells or fibres appear half embedded in the large-celled parenchyma tissue. Careful observation brings to view a second set of needle-shaped objects, very minute, which from their regularity in shape and size may at once be recognized as crystals or raphides.

To ascertain the true nature of these raphides and fibres, chemical tests were applied, as directed by Strasburger, Goodale and de Bary, with the following results:

Acetic acid has no perceptible effect upon either form,

while hydrochloric acid dissolves the raphides without effervescence, proving them to be calcium oxalate. The fibres are proven to be lignified from their reactions with phloroglucin and hydrochloric acid, also with aniline sulphate and sulphuric acid. Treated with iodine and sulphuric acid a reddish-yellow color is produced, which confirms the above statement. Knowing that these fibres are hard-walled, lignified cells, and that they appear scattered through the parenchyma, they may therefore be placed among the sclerenchymatous tissues. Similar cells to the above, occurring in Aroideæ, Rhizophoraceæ, Nymphæaceæ, and especially those found in the leaf lamina of Monsterineæ, are termed "internal hairs" by de Bary. Concerning them he says:[1] "Numerous hairs are contained in the cavities and passages of the lamellar parenchyma. * * * * They closely resemble sclerenchymatous fibres and were therefore first described as 'bast cells' by Schleiden." Farther on he makes the statement that hard-walled hairs are fundamentally related to sclerenchymatous fibres in every respect and are special cases of the latter, distinguished by form and distribution.

On taking longitudinal sections from various parts of the plant, the fibres are found to occur in every part. But in no part are they found in so great numbers nor so perfectly developed as in the exocarp or outer portion of the fruit. Here they resemble true bast fibres, with but little branching, while in the leaf lamina and spathe, especially, they are very slender and variously branched, filling the interstices of the surrounding tissue and resembling the "internal hairs" described by de Bary.

For a general description of the fibres it may be stated that the walls are very evenly thickened, possessing no projections nor characteristic markings. They are firm in texture but not brittle as wood fibres. In length they are from .9 mm. to 1.6 mm.; in diameter from .015 mm. to .03 mm. Their contents are similar to those of the surrounding cells, but slightly granular. They occur in the parenchymatous tissue situated in the interstitial or intercellular spaces.

While the fibres differ much in size and assume a variety of shapes, due mainly to their promiscuous branching, we find the raphides to be of nearly uniform size and form. Like the fibres they occur throughout the plant in the parenchymatous tissue, but most abundantly in the fruit. Here

[1] Comp. Anat. of Phanerogams and Ferns.

they occur in countless numbers. Lying parallel with one another, they form compact bundles which are situated in narrow elongated cells, known as crystal cells. The raphides are very minute; in length from .01 mm. to .012 mm.; in diameter about .002 mm. They are many sided, with angles and faces poorly defined, and possess sharp ragged ends. In addition to raphides, isolated stellate crystals are also found in the fruit of Monstera.

Concerning the early developement of fibres, de Bary states that they arise by early outgrowth of a cell of the wall of the cavity (usually one layer of cells thick), which remains relatively narrow so as to form long, pointed arms. This explanation may be accepted as general, but it has not been satisfactorily proven in this special plant.

Finally, we may draw the conclusion that since the raphides are so minute, and form such a small quantity compared with the fibres, and since the action of calcium oxalate is very slight, the peculiar sensation caused by placing a piece of the outer fruit in the mouth must necessarily originate from the mechanical action of the sharp-pointed sclerenchymatous fibres, and not from any chemical action of the raphides.

Purdue University, Lafayette, Ind.

EXPLANATION OF PLATE X.—Fig 1. Fruit of Monstera deliciosa. Fig. 2. Section of fruit showing structure; *a*, endocarp or core; *b*, hexagonal segments or fruit proper; *x*, mesocarp or edible portion; *y*, exocarp. Fig. 3. Exocarp dissected under low power: *a*, fibers, *b*, raphides. Fig. 4. Fiber and raphides under high power. Fig. 5. Cross-section of "fruit proper;" *a*, cross-section of fibre. Fig. 6. Longitudinal section of "fruit proper;" *a*, crystal cell; *b*, parenchyma cell; *c*, fibre.

Our worst weeds.

BYRON D. HALSTED.

It is due to those who have already aided me in the study of the weed flora of the United States that some preliminary report be given. The first twenty-five lists which have been received contain in all 267 species, and represent 14 states, ranging from Massachusetts to California, and Wisconsin to Texas. As, in the present article, we are to deal with the worst weeds, attention will be confined to those which appeared at least five times in the lists. Of these there are 34 species, which will be enumerated below.

To those who may not have chanced to see the kind note of the editors of the GAZETTE (xiii. 327), setting forth my wishes, it may be said that the call was for at least the twenty worst weeds in any locality or territory which any one would be pleased to report upon. In nearly all instances the weeds were given their rank as to injuriousness, and from such reports the present article is made up. Following each species will be observed a fraction: the numerator indicates the number of times the species appears in the twenty-five lists, while the denominator is the sum of all the rank numbers. Thus, Agropyrum repens has the fraction $\frac{8}{31}$, which indicates that this "quack-grass" or "quick-grass" appears eight times in the twenty-five lists, and that the rank total is thirty-one, the respective ranks being 5, 1, 4, 3, 9, 2, 5, and 2. As another illustration, Chrysanthemum Leucanthemum, or "ox-eye," "ox-eye daisy," or "bull's-eye," also has eight mentions, but the sum of the rank figures, 4, 16, 17, 9, 5, 11, 6, 12, is eighty. It will be seen that the fraction following each species therefore indicates the rank of the injuriousness of each sort, as far as averages can do it in connection with the wide or limited distribution of the species. The thirty-four are as follows, arranged alphabetically:

Agropyrum repens, $\frac{8}{31}$.
Amarantus albus, $\frac{2}{75}$.
Amarantus retroflexus, $\frac{12}{107}$.
Amarantus spinosus, $\frac{3}{44}$.
Ambrosia artemesiæfolia, $\frac{15}{169}$.
Ambrosia trifida, $\frac{2}{52}$.
Arctium Lappa, $\frac{12}{127}$.
Asclepias Cornuti, $\frac{1}{13}$.
Bidens frondosa, $\frac{2}{77}$.
Brassica Sinapistrum, $\frac{1}{42}$.
Capsella Bursa-pastoris, $\frac{11}{135}$.
Cenchrus tribuloides, $\frac{2}{52}$.
Chenopodium album, $\frac{15}{152}$.
Chrysanthemum Leucanthemum, $\frac{8}{80}$.
Convolvulus sepium, $\frac{2}{87}$.
Cnicus arvensis, $\frac{2}{16}$.
Cnicus lanceolatus, $\frac{6}{75}$.
Datura Stramonium, $\frac{2}{60}$.
Erigeron annuum, $\frac{2}{50}$.
Hypericum perforatum, $\frac{2}{60}$.
Panicum Crus-galli, $\frac{6}{71}$.
Panicum sanguinale, $\frac{11}{75}$.
Portulaca oleracea, $\frac{20}{201}$.
Rumex Acetosella, $\frac{11}{61}$.
Rumex crispus, $\frac{11}{119}$.
Rumex obtusifolius, $\frac{2}{50}$.
Setaria glauca, $\frac{2}{50}$.
Setaria viridis, $\frac{2}{77}$.
Solanum Carolinense, $\frac{2}{63}$.
Solanum rostratum, $\frac{5}{77}$.
Taraxacum officinale, $\frac{2}{53}$.
Vernonia fasciculata, $\frac{6}{60}$.
Xanthium Canadense, $\frac{2}{45}$.
Xanthium stramonium, $\frac{2}{58}$.

The numerators may fairly indicate the prevalence of the weed. Thus Portulaca oleracea, the common purslane or "pusley," has the most frequent mention, namely, 20 out of the 25; while Solanum rostratum, the Texan nettle or beaked horse-nettle, is only five times reported in the list,

but is a vile pest moving northward and eastward, and if not checked in its course will bring dismay to thousands of farmers who now know nothing of its pernicious habits.

The interested reader can quickly select from the table the species which are most prevalent over the whole United States, but the relative injuriousness, which is obtained by dividing the denominator by the numerator, is not so easily seen. The following list of 20 is therefore given in the order of injuriousness, beginning with the worst:

Cnicus arvensis.	Setaria glauca.
Agropyrum repens.	Chenopodium album.
Xanthium Canadense.	Chrysanthemum Leucanthemum.
Cenchrus tribuloides.	Portulaca oleracea.
Panicum sanguinale.	Rumex crispus.
Ambrosia artemisiæfolia.	Panicum Crus-galli.
Xanthium stramonium.	Convolvulus sepium.
Rumex Acetosella.	Capsella Bursa-pastoris.
Amarantus retroflexus.	Cnicus lanceolatus.
Ambrosia trifida.	Arctium Lappa.

The writer is anxious to add to the number of his reports, and will be pleased to hear not only from every state and territory in the Union, but in such numbers that the summary derived from them may furnish a basis for future calculations, if not for national legislation. Questions of eradication, quarantine and the like, come naturally after the nature of the pests has been settled upon in the broadest sense. The greater part of this work must be done by local observers who are willing to aid in arming ourselves as a nation against a vast array of active enemies to American agriculture. If any one will add to or take from the list of 34 species herein given, let him do so as a bit of public service.

New Brunswick, N. J.

Sweet Cassava (Jatropha Manihot.)

H. W. WILEY.

About the middle of March, last year, I received from Mr. R. H. Burr, of Bartow, Fla., a package of cassava roots. These roots reached the department in fine condition, being apparently as fresh as the day they were taken

from the soil. After careful sampling and cleaning a sufficient quantity of the roots was cut into thin slices and thoroughly dried. In a definite weighed portion, sampled as carefully as possible, the percentage of moisture was determined. The dried and powdered roots were preserved for future analysis. Owing to a press of other matter this analysis was not made until the latter part of July and the first of August, 1888. Mr. Burr, in forwarding the roots, sent the following information concerning them:

"The roots do not last long after digging, drying up or rotting. Since this variety of cassava is not the bitter or poisonous kind, it is generally known in Florida as the sweet cassava. The roots are fed to all kinds of stock in a fresh state and are greatly relished. It has been sufficiently tested here to show its great value as stock food. The yield, under favorable conditions, is astonishing. I have recently dug one plant of one year's growth which weighed fifty pounds, being at the rate of more than 1,500 bushels to the acre. Eight hundred to one thousand bushels per acre can be confidently reckoned on."

The roots received by us were long and slender and of various sizes; some of them were quite two feet long and weighed several pounds. The bark, which contains a poisonous principle if any be present, was carefully scraped off and has been preserved for subsequent examination. The analysis of the sample calculated to dry substance, is given in the following table:

Serial No.	5547	
Ash	1.94	per cent.
Oil (petroleum ether extract)	1.27	"
Ether extract (glucosides, alkaloids, organic acids, etc.)	.74	"
Alcohol extract (amids, sugars, resins, etc.)	17.43	"
Crude fibre	4.03	"
Starch	71.85	"
Albuminoids (calculated from nitrogen)	3.47	"
	100.73	

In regard to the method of analysis little need be said; it was carried on in accordance with the well-established rules of plant analysis as laid down by Dragendorff. The first extraction of petroleum ether gave the fat or oil alone, and the subsequent extraction with sulphuric ether gave the glucosides, alkaloids and organic acids. That portion of nitrogen existing as amids has been estimated in the alcoholic extract. The total nitrogen was also estimated and entered as albuminoids; a small portion of the nitrogen has thus been counted twice in the total results which add up a little over 100. A characteristic feature of the cassava root is shown in the large amount of substance present soluble in

alcohol. The amount of starch also compares fairly well with the best varieties of potatoes. On account of the large quantity of sugars present the cassava root could be more economically used for the manufacture of glucose than for starch; there is no doubt, however, of the fact that a fine article of starch food can be made from the cassava root growing in this country.

In addition to the fresh root above noted, two samples of the dried root or cassava meal have also been examined. No. 5,922 was sent to us described as pulverized manihot root or cassava flour. The root is first peeled, chopped into thin slices, dried in the sun two days and pulverized. It was prepared by Prof. W. H. Kern, of Bartow, Fla. No. 5,923 was labeled pulverized cassava with the starch, or a portion of it, and the glucose washed out, the remaining pulp dried in the sun, prepared by W. H. Kern, Bonnie Lake, near Bartow, Fla.

Prof. Kern sent a letter with the samples, from which the following extracts are made:

"Allow me to say that owing to the prodigious yield per acre of what we here know as cassava and its alleged value as a feed and food plant and for its yield of starch and glucose, it is attracting a very great deal of attention here now. The plant here grown is different from the manioc root of South and Central America; our root contains no poisonous elements which need to be dissipated by heat. It is customary here for many persons to make their own starch from it. The root, which must remain in the ground until one is ready to use it, is dug, washed and its two inner and outer peelings removed; it is then grated and the pulp washed, the water poured off in a vessel and allowed to stand, when the pure starch settles in the bottom. The clear water is again drawn off and the starch allowed to dry. The pulp, after having the starch washed out, may be used at once in making puddings by the addition of milk, eggs, etc. This washed pulp may be sun dried and thus kept, forming valuable meal or flour from which nice bread may be made. Necessitated, as we are in South Florida, to buy all our wheat flour, anything which acts as a substitute, either in whole or a part, is of great value to us."

The analysis of two samples of flour are given in the following table:

Serial No.	5922	5923
	Per Cent.	Per Cent.
Water	10.56	11.86
Ash	1.86	1.13
Oil and fat	1.50	.86
Glucosides, alkaloids and organic acids	.64	.43
Amids, sugars, resins	13.69	4.50
Dextrine, gum, etc., by difference	2.85	5.63
Crude fibre	2.96	4.15
Nitrogenous bodies	1.31	1.31
Starch	64.63	70.13

From the above analyses it is seen that the cassava can never take the place of the flour made from cereals as a food material on account of the small portion of nitrogenous matter which it contains. It seems to me, however, that it might very well take the place of potatoes, and its value as a food should not be underestimated.

Mr. S. W. Carson, of Midland, Fla., has made some very valuable contributions to the literature of the native cassava. From a letter of his to the *Florida Farmer and Fruit Grower* of April 11, 1888, I make the following quotations:

"As before stated, I regard the rolling pine lands, containing some willow oak, to be the best for cassava, and the southern counties to be the best suited to it. Let the soil be well prepared by plowing and harrowing, rows checked about four feet apart, one piece laid in each hill. I think they should never be closer together than four feet, and five would be better. Cassava has been known to grow for three years in this country. It will continue to grow until the cold kills it, then by breaking off the stems when they are red, the stubble will sprout up in the spring. As to the seeds of the cassava they will ripen in about one year. If puddings, custards, etc., are desired, the roots must be peeled and grated; salt, sugar, etc., may be used according to taste. The Spaniards make bread of it simply by grating the root and adding salt and a little soda. Now, there is no doubt in my mind but thirty tons of cassava root per acre can be produced. When I think of the tapioca, glucose and starch there are in it, and how abundantly it can be turned into bacon and lard, milk and butter, mutton and beef, I feel confident that it will pay better than any other plant in the world."

Mr. J. H. Moore, of Keuka, Fla., in a letter to the same paper of November 24, 1887, describes some of the uses of cassava. From his letter I make the following extract:

"Cut the stalks about one inch above the ground, just before frost; after cutting, the stalks should be left to dry in a cool place a few weeks, and then placed in a trench and covered until time for planting. Some save the stalks by keeping them in a dry, cool place until February and then plant. The roots should be dug as used; they will not keep in good condition out of the ground more than three or four days. It is, perhaps, the best feed we can raise for hogs; it is also a fine feed for poultry. We often bake it like sweet potatoes, and also slice and fry it like Irish potatoes."

M. Sacc has addressed a letter to the National Society of Agriculture of France concerning cassava, which he calls "Manihot utilissima." He is of the opinion that the poisonous varieties are different botanically from the innocent. Manihot is the bread of tropical regions. The innocent variety is cultivated in Bolivia, and the botanists there call it "Manihot Aïpi." The plant grows from one to two metres in height, with straight and naked stalks, since they only develop leaves at their extremities. The only care given

to them in their cultivation is to keep them free from weeds. The roots, to the number of 5 to 9, are of the size of the closed hand. The following analysis of the roots of the Manihot Aïpi is given:

Water	70.29 per cent.
Starch	14.40 "
Sugar, salts and malic acid	1.01 "
Fibrin and yellow coloring matter	.08 "
Crude fibre	3.16 "
Ash	10.82 "

From the above it is seen that the roots of the tropical plant are quite different from those produced in our own country. In regard to the distribution of the two varieties, M. Sacc makes the following observation:

"In Cuba I have seen only the poisonous variety. The same is true of Brazil, where I have not seen the Manihot Aïpi except in the Swiss colony, Porto Real. As to the product of the two varieties it is the same; the stalks, which are the size of the finger, are from one to two metres in height. I have not been able to analyze the leaves of this interesting vegetable, but, as they are much sought after by cattle, they are probably very nutritious."

The above quotation from M. Sacc's paper I have taken from the *Revue Agricole*, published at Port Louis, Maurice, vol. 2, no. 6, pp. 81 and 82.

The name cassava should be applied properly only to the purified starch derived from the roots of the plant. The plant is known under the botanical names, Janipha Manihot, Manihot utilissima, Jatropha Manihot, Manihot Aïpi and Jatropha Læfllingii; it is also called the mandioc plant. The fleshy root of this plant yields the greatest portion of the daily food of the natives of tropical America, and its starch is known in this country under the name of tapioca. Manihot is a woody or shrubby plant, growing from fleshy tuberous roots, the stems being smooth, the leaves being generally long-stalked. The leaves of the poisonous variety usually have seven branches palmately divided: the leaves of the sweet variety are usually only five-parted. In the "Treasury of Botany," p. 718, the following remarks are made concerning these two varieties:

"It is quite clear that while the root of one is bitter and a virulent poison, that of the other is sweet and wholesome, and is commonly eaten cooked as a vegetable. Both of them, especially the bitter, are most extensively cultivated over the greater part of tropical America, and yield an abundance of wholesome and nutritious food: the poison of the bitter being got rid of during the process of preparation it undergoes. The poisonous expressed juice, if allowed to settle deposits a large quantity

of starch known as Brazilian arrowroot or tapioca meal, from which the tapioca of the shops is prepared by simply torrefying the moist starch upon hot plates, the heat causing the starch grains to swell and burst and become agglutinated together. A sauce called *cassareep*, used for flavoring soups and other dishes, particularly the West Indian dish known as pepper-pot, is also prepared from this juice by concentrating and rendering it harmless by boiling. Another of the products of cassava is an intoxicating beverage called *piwarrie*, but the manner of preparing it is not calculated to render it tempting to Europeans. It is made by the women, who chew cassava cakes and throw the masticated material into a wooden bowl, where it is allowed to ferment for some days and then boiled. It is said to have an agreeable taste."

From the above analysis of cassava root, descriptions of its uses and the amount of it that can be produced per acre, it is evident that it is destined to become a valuable agricultural product of the sub-tropical portions of our country.

Washington, D. C.

Histology of the leaf of Taxodium. I.

STANLEY COULTER.

(WITH PLATE XI.)

Following Endlicher, in his *Synopsis Coniferarum*, 1847, Taxodium distichum is placed in the sub-order Cupressineæ. Sachs suggests, however, that this arrangement of the Coniferæ can only be considered tentative, until further light is thrown upon the nature of female flowers of various genera.[1] As it is not the purpose of this paper to present any fact regarding this point, a general description of the appearance of the tree is alone given.

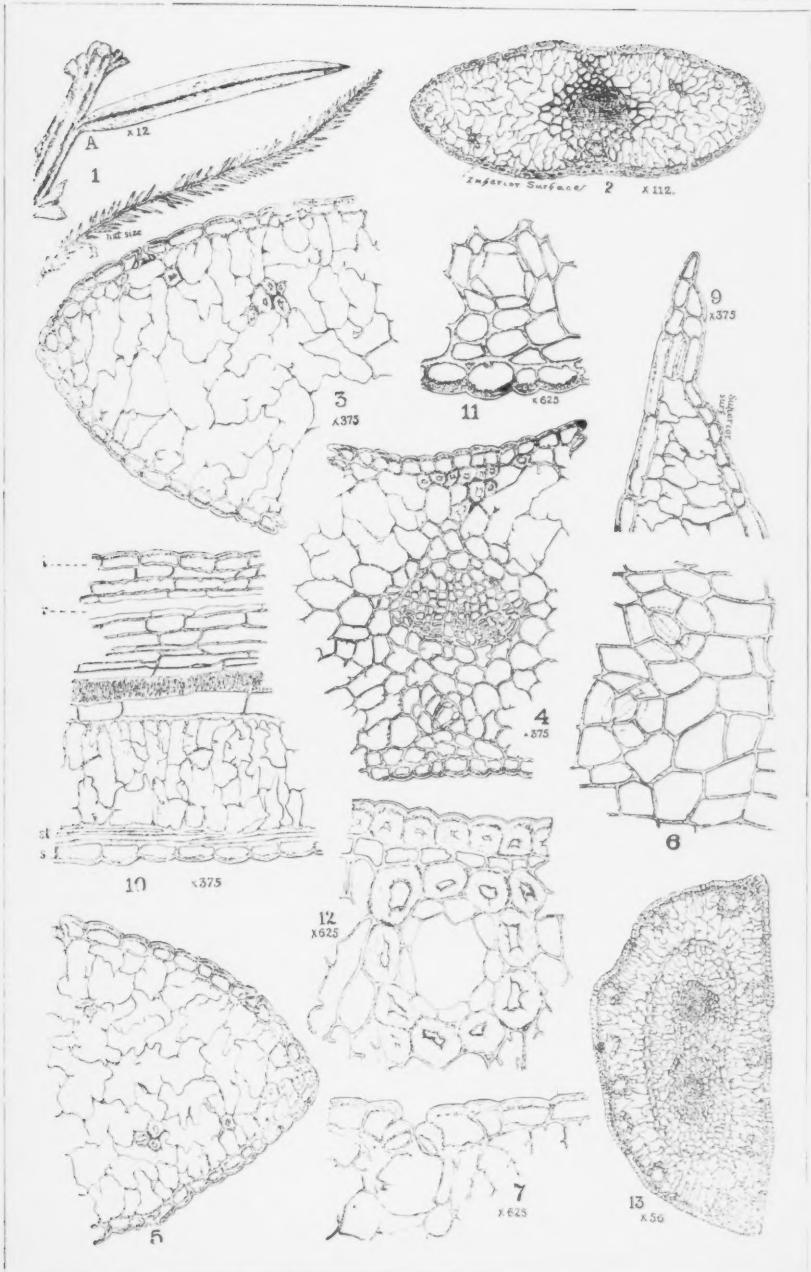
Under favorable circumstances, Taxodium distichum, the Ahuahete of the Mexicans, "reaches a height of 150 feet, with a trunk diameter of from 10 to 12 feet or more."[2] According to Humboldt, attaining a height of 120 feet, it has a diameter of from 32 to 40 feet.[3] It bears linear, acute, 2-ranked, crowded and deciduous leaves, from 5 to 8 mm. long, upon slender leafy branchlets, a part of which are also deciduous in autumn. Its range in the United States is from southern Delaware to southern Florida near the coast, and from Carroll county, Indiana, southern Illinois and Missouri, southward to Alabama, Louisiana and eastern Texas.[4]

[1] Sach's Text Book of Botany, 1st English Ed., p. 459.

[2] Sargent's Catalogue of the Forest Trees of N. A., p. 65.

[3] Aspects of Nature II, p. 94.

[4] Sargent's Catalogue Forest Trees of N. A. l. c.



S. COULTER on LEAF OF TAXODIUM.

Of extreme beauty and grace, it is the most frequently planted of the hardy deciduous Conifers for ornament,[5] while its light, compact and durable wood gives it a great value from an economic standpoint. In our own state (Indiana), while its range commences as far north as Carroll county, it is not found in any abundance until we reach the low lands of the lower stretches of the Wabash, where its large trunk with its pale, smoothish bark and its yew-like foliage, makes it a striking feature in the landscape.

In the study of the foliage leaf, great difficulty was encountered in the securing of sections in which tissues were not either lacerated by the razor or distorted by pressure. The strongly cuticularized epidermal cells and the extremely thin-walled cells of the mesophyll, may in a certain measure account for this. Various methods of imbedding were tried, but none succeeded. The method of Moll[6] brought some hope with it, although it was suggested in the article that with fully grown parts, perfect imbedding was extremely doubtful. A careful following of directions there given gave no satisfactory results, nor was any greater success attained in cases in which a portion of the epidermis had been removed.

The sections used in the study are therefore all free-hand, but so large a number of these was prepared that the results attained are considered accurate.

The gross appearance of the leaf is shown in fig. 1, in which "B" shows a leafy branchlet with its crowded 2-ranked, linear leaves, natural size; while "A" gives a single leaf in position, magnified 12 diameters.

In some of the leafy branches the leaves show a marked tendency to depart from their distichous arrangement, in some cases almost forming whorls, in others taking positions referable to no definite plan. Specimens received from different localities show such a variation in habit and size of foliage that it is not strange that many varieties and some species have been founded upon them.

I have in these studies made constant comparisons with the structure of the foliage leaf of Pinus sylvestris, which may perhaps be taken as a fair representative of that genus.

In transverse section, the leaf presents an almost perfectly elliptical outline, the variations consisting in the somewhat acute form in the direction of the longer axis, and a depres-

[5] Hemsley's Hardy Trees, Plants and Shrubs, p. 451; Paxton's Bot'l Dict'y, p. 549.
[6] BOTANICAL GAZETTE, xiii. 5.

sion on both leaf surfaces in the direction of the shorter axis (fig. 2).

In passing from the periphery to the center, three distinct regions are to be noticed: (1) A well-defined epidermal system; (2) the mesophyll, made up for the most part of somewhat large parenchymatous cells; (3) the fibro-vascular bundle near the center.

I. *Epidermal system.*—The epidermal cells in transverse section show a slight irregularity both in size and shape. The prevailing form appears to be elliptical, with the longer diameter, in the line of the greater leaf axis, to the shorter as two or three to one. In the depressions referred to above, which occur immediately above and below the fibro-vascular bundle, the cells become more nearly equal in their diameters, and in some cases that in the direction of the shorter leaf axis is the greater. At the extremities of the longer leaf axis the epidermal cells are somewhat peculiarly modified. The extreme cell is ordinarily much smaller than those on either side, which by their excessive development and remarkably thickened inner walls separate it entirely from the underlying parenchyma. In occasional cases this modification of the adjacent cells is not so marked, but there is found instead one or more rows of thick-walled "strengthening cells," extending from the apical cell back into the parenchyma. This arrangement is evidently a special one, as nowhere else does the epidermis show the slightest tendency to become of two layers, and at this point the mode of its occurrence is such that it probably can not be referred to this condition. In these smaller apical cells, the walls are of comparatively great thickness, almost obliterating the cell cavity. No marked differences are to be observed in this section between the epidermal cells of the outer and inner surfaces, unless it be that in the latter the average cell length is less than in the former. (See figs. 2, 3, 4 and 5.)

A surface slice (fig. 6) shows the epidermal cells to be of somewhat irregular outline, with their diameters of varying proportion to each other. They are, however, more nearly isodiametric than would be expected in a plant with narrow linear leaves, in which case, according to de Bary, "the longitudinal diameter is greatly extended."[7] The outer walls are heavily cuticularized and in nearly equal degree throughout the outline of the leaf. The cuticular layers are extremely dense and tough. The non-cuticularized layer is rela-

[7] De Bary, Comparative Anatomy of Phanerogams and Ferns, p. 30.

tively thick, and shows no tendency to thin out where it borders upon the cuticular layers. In this it resembles the condition in Pinus, and differs from that found in the under surface of the leaf of Taxus baccata, in which the non-cuticularized layers are scarcely to be detected where they border upon the cuticular.[8]

The cuticularized portions follow the outer surface of the epidermal cells and project inward in somewhat sharply-pointed conical form. In many instances the cuticular layer is largely developed at the stomatic furrow, although as a rule this may not hold.

The epidermal cells contain nothing further than the characteristic contents of such cells, although in the cuticular layers are found thickly massed granules, presumably calcium oxalate, as treatment with acetic acid produced no effect, and as this substance is not uncommon in the Cupressineæ.[9] No crystalline forms were found, and although the substance was present in comparatively large quantities, no modification in the coloration of the epidermis could be detected. The walls of the epidermal cells, especially the inner ones, are extremely irregular and show numerous infoldings, which in some instances are very prominent. There seems to be no special order in their disposition, either as regards the individual cell or the other tissues of the leaf, although the larger forms are more frequently found in the region of the resin duct than elsewhere. It is also possible that those of the inner leaf surface may be more prominent than those of the outer. The purpose of these infoldings I have been utterly unable to determine, their irregular arrangement and development negativing every conjecture. In view of some facts to be presented later in this paper, it is at least within the range of possibility that they serve for purposes of support.

A median vertical longitudinal section illustrates still further these points (fig. 10). The apex of the leaf is formed by a continuation of the epidermal cells of the inner surface, the apical cell being of this series. The two cells immediately adjoining the apical cell of both the outer and inner surface are in immediate contact, no parenchyma intervening. Those of the outer surface are much modified in form, while those of the inner retain their normal shape. At the third cell from the apical cell, there occurs a peculiar modification, due either to the presence of extremely short

[8] De Bary, Comparative Anatomy of Phanerogams and Ferns, p. 77.

[9] De Bary, l. c., p. 102.

"strengthening cells," or to the division of the epidermal cell of the outer leaf surface into three layers. This arrangement serves, of course, to give still further rigidity to the leaf apex. At this part of the leaf the epidermal cells of the inner surface are much longer than those of the outer surface (as seen in this section), seeming in the one case to be lengthened, in the other shortened (figs. 9 and 10, cf. also fig. 3).

The stomata in surface slice appear widely elliptical and have the depressed position usually found in thick-skinned parts. In size, they are perhaps from one-third to one-half that of the surrounding epidermal cells, and are relatively equal to each other. The stomata are irregularly arranged in this view, both as regards the surrounding epidermal cells and the relation of their axes. In transverse section the guard cells are almost perfectly oval, with their outer walls heavily thickened or from three to five times thicker than their inner walls. This thickening appears to be greatest at or near the point of union with the subsidiary cells, but extends in an almost undiminished degree to the free ends. The free ends show no difference either in shape or size from the united ends, presenting a marked contrast to Pinus, in which the reverse is true. They meet each other at an angle of about 45° as referred to their longer diameter, and open into a remarkably large respiratory cavity. (Fig. 7.)

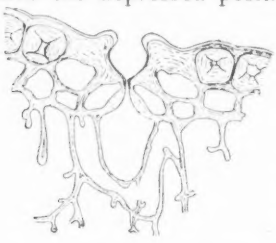


Fig. 8. Section of stoma of Pinus sylvestris × 650.

The adjoining epidermal cells are but slightly modified, those immediately adjacent having their lateral walls which join the guard cells modified in shape only as would be indicated by the outline of the guard cells. The inner walls of these cells are in most cases more irregular in outline and more heavily thickened than the ordinary epidermal cell.

The guard cells are depressed below the surface about one-half the height of the epidermal cells, so that in a surface slice it is necessary to focus down to bring them in view. The epidermal cells next removed from the subsidiary cells are somewhat shortened, becoming almost isodiametric as viewed in both transverse and surface sections. The subsidiary cells are also as a rule more heavily thickened and cu-

ticularized at the stomatic furrows than elsewhere. The intercellular cavity shows numerous and somewhat prominent infoldings, a characteristic common also to Pinus. The contents of the guard cells are protoplasm and chlorophyll with their included bodies.

A transverse section usually shows eight stomata, in relatively definite positions, six on the outer and two on the inner surface of the leaf. In exceptional cases the number may vary upon the outer surface, but in the sections examined no more than two have been detected upon the inner surface. Upon the upper surface the stomata are usually about equidistant from each other. Those of the inner surface seem to be placed about midway between perpendiculars let fall from two of the upper stomata. (Figs. 2, 3, 4, 5 and 7.)

The stomatic system seems to be of the simplest and is much different from that in Pinus sylvestris in the shape and thickening of guard-cells, in the modifications of the subsidiary and surrounding epidermal cells, and in the shape and outline of the furrow. The similarity consists chiefly in the relatively large respiratory cavities and the infoldings mentioned above. As a whole, in comparison with Pinus the stomatic mechanism seems much less completely developed both as regards its differentiation from the surrounding tissues and its means for controlling transpiration. (Cf. figs. 7 and 8.)

Purdue University, Lafayette, Ind.

OPEN LETTERS.

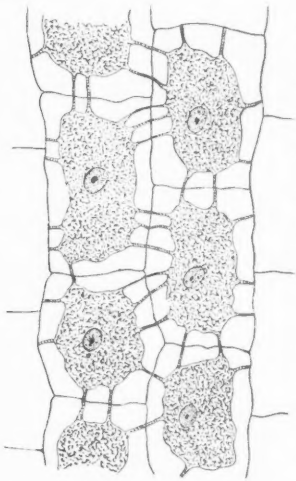
The "King-Devil."

In connection with Mr. Lester F. Ward's article on the "King-Devil" in the January GAZETTE, it may be interesting to note that *Hieracium aurantiacum* L. has appeared on my place here. The locality is in a wet meadow, and I first discovered it in the summer of 1884, when there was a single flowering stalk. This has increased slowly until last summer there were six or eight flowering stalks, but so far it has shown no indications of becoming a troublesome weed. As to the manner of its introduction, I can only say that my uncle, the late Mr. Oscar Harger, of New Haven, once had the plant growing in his garden, and it may have been introduced from there in some way, although as the distance is about fifteen miles, the probability seems small. E. B. HARGER.

Oxford, Conn.

BRIEFER ARTICLES.

Continuity of protoplasm.—In demonstrating this very important fact, Strasburger[1] directs the use of the strongest objectives, and, where possible, immersion objectives. This at once puts it out of the reach of many laboratories, where the teacher is thankful if he gets enough ordinary objectives. The information, therefore, that protoplasmic continuity can be easily demonstrated, with very little manipulation and very ordinary objectives, ought to be helpful to many. The most favorable object used is the secondary cortex or "green bark" of dicotyledons. Strasburger suggests the buckthorn, Rhamnus Frangula; Goodale mentions any "dicotyledonous shrub or tree." In most of these cases the connecting fibrils are so delicate that the highest objectives are neccessary to demonstrate them. But in the common buckeye the strands which connect the plasmic bodies are so large as to be satisfactorily seen with a magnification of 250 diameters, and very well studied with a magnification of 500 diameters, and in neither case is there any necessity of using an immersion objective. To repeat very briefly the method of preparing the specimen, and omitting all details that were found unnecessary, it is as follows: Use a buckeye twig about ¼ to ½ inch in diameter (those a year or two old seem best); carefully slice off the periderm so as to expose the "green bark"; make a thin tangential section from this latter; immerse this in an aqueous solution of iodine (or, better, iodine in a solution of potassic iodide) until it turns brown, which will take but a moment; wash the section thoroughly to remove excess of iodine; mount in water; at the edge of cover slip put a drop of chemically pure sulphuric acid and two drops of dilute (about 75 per cent.) sulphuric acid, and draw this mixture under[2]; thoroughly wash the specimen by drawing plenty of water through (this is very important); replace the water of the mount with glycerine and the specimen is ready to observe. If the work has been successfully done, even a low power will reveal the very much swollen and transparent walls crossed in every direction by proto-



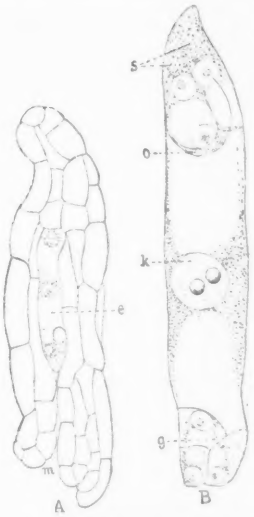
Continuity of protoplasm in secondary cortex of buckeye.

[1] Practical Botany, Hillhouse translation, p. 370; Hervey translation, p. 364; described in Goodale's Physiol. Bot., p. 216.

[2] It may be easier to dip the section directly into the sulphuric acid and then wash thoroughly.

plasmic strands connecting the contracted brown plasmic bodies as shown in the accompanying cut. To make a permanent mount, it will be necessary to use some stain for the plasmic bodies and their connecting strands; otherwise the strands gradually become so transparent in the glycerine as to be almost invisible. The ease of demonstration in case of the buckeye, as compared with other dicotyledons previously used, depends upon the fact that the plasmic protuberances do not break up into delicate fibrils on entering the walls. This demonstration was made by Mr. Evans, my assistant, and the sketch by Mr. Seaton, a special student. —JOHN M. COULTER, *Botanical Laboratory, Wabash College.*

Monotropa uniflora as a subject for demonstrating the embryo-sac.— In the "Botanisches Practicum,"[1] Strasburger figures the embryo-sac of Monotropa Hypopitys as the most favorable plant known to him for its study in the living state.



A. Ovule of Monotropa uniflora in optical section, X about 100: *m*, micropyle; *e*, embryo sac. B. The embryo-sac of a similar ovule, X about 300: *s*, synergidæ; *o*, oosphere; *k*, endosperm nucleus (the two endosperm nuclei have united, but their nuclei are still distinct); *g*, antipodal cells.

I have found M. uniflora to be even better suited to this purpose owing to the greater size of the ovules and embryo-sac, the latter being just about twice as long as that of the former species, and showing quite as clearly all the details of its structure.

It is only necessary to strip away a little piece of the placenta with the adherent ovules and mount in water, or, better still, a weak (about 3 per cent.) sugar solution. In the latter fluid the ovules remain unchanged for several hours, and may be studied at leisure.

The embryo-sac is covered with but two layers or cells, and these are perfectly colorless, so as not to interfere in the slightest with the view of the embyro-sac.

M. uniflora is not at all a rare plant and may usually be had throughout the summer. The specimen from which the accompanying figures were made was collected at Bloomington, Sept. 24.

The figures are from camera drawings and will give a good idea of the structure of the ovule and embryo sac.—DOUGLAS H. CAMPBELL, *Bloomington, Ind.*

[1] Hillhouse's translation, p. 331.

EDITORIAL.

THE AGRICULTURAL EXPERIMENT STATIONS are now fairly launched on their way, and their reports are beginning to come in rapidly. Some of them are valuable, some are worthless, evidently having been made to order. It is, perhaps, hardly fair to make such a criticism so early in the history of these stations, but we wish to do them a service if possible. The requirements of a report at certain stated intervals is American, but dreadfully unscientific, and the general supposition is that at these stations, at last, we have endowment for research and not simply one for "reports." If they are to begin at once with reports upon all sorts of hasty and meaningless experiments, we shall be worse off than we were before. We thoroughly understand that many in charge of this work can not perform any other kind of experiments, and concerning these we have nothing to say. But there are those in charge who know how to work, for they have already made a record, and we want to see the opportunity given them. The popular American idea is to experiment two or three weeks, and then write a report, and if real workers are compelled to come under such an order of things, their publication can be but little better than others. We would protest, therefore, against compelling a botanist at one of these stations to write a report when he has nothing to say. He must not be hurried even, for the best experimental work can only be done with the idea of unlimited time as a factor. A station director must know that his man is competent, that he is actually doing work, and then wait patiently for results. The ability to get out a report at short intervals ought to be taken as an indication of a man's incompetency as an investigator. If the requirement of "reports" from the scientific staff of these stations could be removed, and only monographs prepared after ample investigation, our new venture might really prove the beginning of an endowment for research.

CURRENT LITERATURE.

Watson's Contributions to American Botany.

A great herbarium should always be productive, and it is of inestimable advantage to American botanists that our greatest herbarium has always had in it men with the spirit and ability to work. The accumulation of a great herbarium which contributes little or nothing to general botanical knowledge is hardly better than a miser's accumulation of money. The "Contributions" from the Harvard Herbarium form a set of botanical publications that no working botanist can be without, or else he will be working in the dark.

The last of these is before us.[1] The first part is a report of a collec-

[1] WATSON, SERENO.—Contributions to American Botany. xvi. (Proc. Am. Acad. xxiv, pp. 36–87). Issued Jan. 31, 1889.

tion of plants made by Dr. E. Palmer, in 1887, chiefly about Guaymas, Mexico. The season was very dry and unfavorable, and this, too, in a country that is normally dry and unfavorable, and yet 415 native species were collected, 89 of which are wholly new. This region of the Gulf of California is one of great interest botanically. It is probably the northern limit on the Pacific coast of such tropical genera as Rhizophora, Hæmatoxylon, Citharexylum, Ficus, etc. Among the 415 species, there are 50 Gramineæ, 50 Compositæ, 44 Leguminosæ, and 32 Euphorbiaceæ. The important orders Ranunculaceæ, Rosaceæ, Saxifragaceæ, Umbelliferæ, Ericaceæ, Cupuliferæ, Coniferæ, and Orchidaceæ are wholly unrepresented. Excluding Cyperaceæ and Gramineæ, there are only 5 endogenous species in the entire collection. The new genera proposed are *Malperia* (Agerateæ among Compositæ), *Pluchea* (Plucheineæ among Compositæ), and *Puttalias* (Asclepiadaceæ). The second part contains descriptions of new species, chiefly Californian, and also proposes the restoration of *Sisyrinchium anceps* Cav. Dr. Watson finds that two forms can be readily distinguished, one (*S. anceps* Cav.) with branching stems and globose strongly pitted seeds less than half a line in diameter, the other (*S. angustifolium* Mill.) with simple stems and angled less pitted seeds about twice larger than the other.

Saccardo's Sylloge Fungorum.[2]

Two more volumes of the Sylloge are before us, volume VI and the second part of volume VII, and but one volume remains to complete this great work. The invaluable service to mycologists in thus bringing together in convenient form descriptions of all known fungi has already been alluded to in notices of the earlier volumes. The present parts follow the treatment already well established, and which it is unnecessary to describe in this connection.

The sixth volume contains descriptions of 3911 species, being more than quadruple the number belonging to these orders known when Fries published his Epicrisis in 1838, and still the harvest of new species is unabated.

The first part of the seventh volume was noticed recently; the second part, now before us, deals with the Ustilagineæ and Uredineæ, two specially interesting groups of parasitic fungi. As there have been many collectors of these plants in North America, there are consequently a considerable proportion of the species accredited to this country—of the Ustilagineæ nearly one-fourth.

As in every other work touching upon the classification of these groups, the protean changes of synonymy bring to light old, new, or little

[2] SACCARDO, P. A.—Sylloge fungorum omnium hucusque cognitorum; Vol. VI, Polyporeæ, Hydneæ, Thelephoreæ, Clavarieæ, Tremellineæ. 928 pp., roy. 8 vo. Patavii, 1888.—58 francs.

Same; Vol. VII, Pars II, Ustilagineæ et Uredineæ, digessit J. B. De Toni. 882 pp., roy. 8 vo. Patavii, 1888.—29 francs.

known names to replace those in use. For example, we find Ustilago Candollei given as Sphacelotheca Hydropiperis, Puccinia Petalostemonis transferred to the genus Uropyxis, established by Schröter for the curious Puccinia on Amorpha, Puccinia vertisepta from New Mexico changed to Diorchidium Tracyi, Melampsora Epilobii and M. Crotonis both placed under Pucciniastrum. One notices by this that a number of genera, not heretofore much in favor, have been reinstated. The Æcidia forms have been distributed so far as possible, and especially so under Gymnosporangium.

The thing that one misses in these volumes, and yet a thing scarcely to be expected in such a compilation, is a critical valuation of the species. In fact it takes no very extensive knowledge of the American flora, to be able to eliminate a number of the so-called species as having no just claim to recognition, and to add to the range of other species. But with all faults of omission and error, to a large part inseparable from such an undertaking, the work is still one of great value, and will do much toward helping and elucidating the systematic study of fungi.

Minor Notices.

Dr. C. C. Parry has just published a revision[3] of the genus Ceanothus, based upon field observations on the Pacific coast covering a period of forty years. The work heretofore has necessarily been done with fragmentary herbarium specimens, and Dr. Parry's observations supply much needed information. Before enumerating the species the author makes some very interesting general observations, and also discusses the characters by which species and groups can be most satisfactorily defined. The Pacific coast of California constitutes the most suitable home for the genus, "and in its varied aspects of soil and climate, invites to the largest display of specific forms." In California the greatest profusion and variety of forms are found in the Santa Cruz range of mountains. Two new species are described, *C. Andersoni* and *C. divergens*.

In the publication referred to above, Dr. Parry discusses certain species of Chorizanthe and describes two new ones, *C. Andersoni* and *C. robusta*.

The first bulletin from the laboratories of Iowa State University is before us. It is a publication of 96 pages, containing eight articles, three of which are botanical, with the following titles: The saprophytic fungi of E. Iowa—the genus Agaricus, Series I and II, by T. H. McBride; The Peronosporeæ in Iowa, by T. H. McBride and A. S. Hitchcock; Botanical notes, by T. H. McBride. The botanical notes speak of spore-dispersal among fungi, an undesirable immigrant (Solanum rostratum), and a mould growing in hydrochloric acid.

[3] Parry, C. C.—Ceanothus L. A synoptical list, comprising 33 species, with notes and descriptions. (Proc. Davenport Acad. V, pp. 162-174.) Issued Feb. 9, 1889.

NOTES AND NEWS.

A GOOD ACCOUNT of the Botanic Garden at Glasgow will be found in *Gard. Chron.*, Jan. 26.

PROF. DR. GOEBEL, of Marburg, assumed with this year the editorship of the well-known journal, *Flora*.

M. HENNECART, Nestor of French botanists, died at Paris, 23d of last December, 91 years of age. He was born in 1797.

THE MICHIGAN Forestry Commission report for 1888 contains much information concerning the lumber interests of that state.

COUNT SOLMS has recently published a MS. monograph of the Saprolegnieæ left by the lamented de Bary. Bot. Zeit. 1888, nos. 38–41.

DR. FR. JOHOW, privatdocent at the University of Bonn, has been called to the chair of biology in the Normal School at Santiago, Chili.

DR. PFEFFER, of Tubingen, has been elected one of the fifty foreign members of the Linnean Society, in place of the late Prof. Planchon.

PROF. JOSEPH F. JAMES has published, in *Jour. Cin. Soc. Nat. Hist.* (Jan.), an account of the distribution of Vernonia in the United States.

THE FOURTH PART of Jane H. Newell's "Outlines of Lessons in Botany" has been published. It consists of a study upon buds and branches.

FRANCIS DARWIN, heretofore lecturer in botany in Trinity College, Cambridge, has been elected lecturer on botany in Christ College, vice Dr. Vines.

IN BULLETIN 3 from the Iowa Agricultural Experiment Station Mr. A. A. Crozier gives a popular description of some of the most common injurious fungi.

BULLETINS 59 and 60 from the N. C. Agricultural Experiment Station contain articles on the purity and vitality of seeds, and the value of lucerne as a forage crop.

REV. ARTHUR C. WAGHORNE, of New Harbor, Newfoundland, has published an account of the wild berries and other edible fruits of Newfoundland and Labrador.

RECENTLY biographical sketches of Dr. de Bary have been published in the Berichte der deutschen bot. Gesellschaft (General-Sammlung) and the Botanische Zeitung (1889, no. 3).

IN *Journal of Botany* (Feb.), *Ptamogeton varians* Morong in herb. is described by Alfred Fryer. It is common to Britain and America, and seems to be the *P. gramineus*, var.? *spathulaformis* Robbins of Gray's Manual.

THE DECORATION of the Legion of Honor was awarded by the French government on last New Year's day to Prof. F. L. Scribner, of Tennessee, T. V. Munson, of Texas, and Jaeger of Missouri, in recognition of their studies of the grape and its diseases.

GUIGNARD[1] reports the results of recent investigation of the development of antherozoids of the Characeæ. The nucleus of the mother-cell forms the whole of the body of the antherozoid, the protoplasm forming the cilia only. In these plants there is no vesicle attached.

[1]Comptes Rendus de l'Acad. Sci. CVIII. 71. See, also, Revue générale de Bot. no. 1.

THE LARGER part of Professor Dudley's article on the Strassburg Laboratory, given in the December number of this journal, has been reprinted in *Nature* for January 17, "as showing the sort of provision for botanical study that is thought right and necessary in Germany."

IN THE *Bulletin of Torr. Bot. Club* (Feb.) Mr. Bebb gives a second paper upon White Mt. willows, in which *Salix phylicifolia* L. is discussed, being *S. chlorophylla* And., Gray's Man. Ed. 5, excl. char. In the same number Mr. Morong gives his first impressions of South American vegetation.

THE INDIANA Agricultural Experiment Station has published a bulletin (No. 19) upon the spotting of peaches and cucumbers. The peach spot is *Cladosporium carpophilum* Thuem., and heretofore has been recorded only as occurring in S. Austria. The cucumber spot is *C. cucumerinum* E. & A.

PLANT ILLUSTRATIONS in recent numbers of the *Garden and Forest* are as follows: *Cereus Pringlei* Watson (Feb. 6), a gigantic cactus of Mexico, not so tall as C. giganteus, but with more ponderous branches than any cactus known; and *Rosa humilis* Marsh. (Feb. 13), the R. lucida of Gray's Manual.

DR. MAXWELL MASTERS (*Gard. Chron.*, Feb. 9), in giving an account (with capital illustrations) of *Abies lasiocarpa* Hook., concludes that, for garden purposes at any rate, *A. subalpina* Eng. should be considered to be *A. lasiocarpa* Hook. and *A. bifolia* Murray; and that *A. lasiocarpa* of the gardens is *A. Lowiana*.

THE SERIES of articles on physiological botany by Dr. Goodale in *Garden and Forest* is of great interest to those botanists who do not keep step with the advance of botany in physiological lines, as it compactly and clearly presents our best knowledge of the subject. The series began in the first number of the current year.

IN *Journal de Botanique* (Jan. 16), Abbé Maselef discusses *Daucus hispidus* DC., referring it to the interminably variable D. Carota, a thing that might be done with our own D. pusillus with no great violence. In the same number N. Patouillard begins a study of the genus Lachnocladium, describing nine species, two of which are new.

DUCHARTRE has recently observed the formation of numerous (as many as twenty) adventitious roots by the endosperm of Cycas Thouarsii, a Comoro species. Most of the seeds are without embryos. The roots start from the neighborhood of the micropyle. If the endosperm is the equivalent of the prothallium, then this is a peculiar form of apogamy.

AN ILLUSTRATED monograph of British Hieracia is being prepare by Frederick Jansen Hanbury. It is to be done in a most elaborate way, appearing in quarterly parts, the estimate being that it will be completed in five years. The annual subscription is 24 shillings for colored, and 16 shillings for uncolored copies. Subscriptions are to be sent to the author at 69, The Common, Upper Clapton, London.

SEVERAL new species of fossil woods have been described by Mr. F. H. Knowlton in the Proceedings of the National Museum for 1888. The diagnostic characters are mostly drawn from the microscopic structure; the plates show the cells in a surprisingly perfect state of preservation. The species include an araucaria (Araucarioxylon) from Arizona, a cypress (Cupressinoxylon) from Iowa, another cypress from Montana, and a palm (Palmoxylon) from Louisiana.

PROF. JAS. ELLIS HUMPHREY, of the Mass. Agricultural Experiment Station, has been invited to act as collaborator on the *Botanisches Centralblatt*, the well-known weekly résumé of current botanical literature. Dr. Uhlworm, the editor, wishes to have the work of American botanists more fully represented in his pages than heretofore, and Prof. Humphrey will be glad to receive reprints of all future American papers containing original matter, for abstract.

AMANN finds that the whitish coating which gives the glaucous appearance to the leaves of Leptotrichum glaucescens is a crystallizable substance which he calls "Leptotrichum-säure." This is the first crystallizable substance yet obtained from mosses. It is soluble in ether and hot alcohol, from which it may be recovered in crystals or a flocculent precipitate respectively. The crystals are tasteless and odorless. The small quantity available has not yet permitted a complete chemical study of the substance.

THE AGRICULTURAL Experiment Station at Knoxville, Tenn., has secured the entire collection of Dr. A. Gattinger of Nashville. This collection is a very valuable one, the result of 30 years of work of an indefatiguable and acute botanist. It is very nearly complete for that very interesting state, and Dr. Gattinger's correspondence has also secured much material from other parts of the United States. With Prof. Scribner in charge of the botany of the station, this rich collection at once becomes the common property of all working botanists.

A WRITER in a late number of *Education* points out that the dictionaries (Webster and Worcester) are wrong regarding the accent and meaning of the word Arbutus. He quotes from Horace, Virgil and Ovid to show that the accent should be on the first syllable, and from Aristophanes and others for the meaning, which is having the properties of the arbor or tree. It will be found that in the works of Asa Gray the word is properly accented, while in Hooker's Flora of the British Isles, and possibly other English works, the accent is on the second syllable.

ANOTHER JOURNAL, the *Revue générale de Botanique*, has been started with the new year, designed to cover all departments of the science. Its list of editors includes such well known names as MM. Bonnier, Dufour, Flahault, Costantin, Leclerc du Sablon and Saporta. It is a monthly of 36 to 48 pages, at 22.50 francs ($4.50) a year outside of France. Subscriptions are to be sent to the publisher, M. Paul Klincksieck, 15 Rue de Sèvres, Paris, and communications and papers for review to M. G. Bonnier, 7 Rue Amyot, Paris. The first number will be sent free to those interested in botany making known their desire to see it.

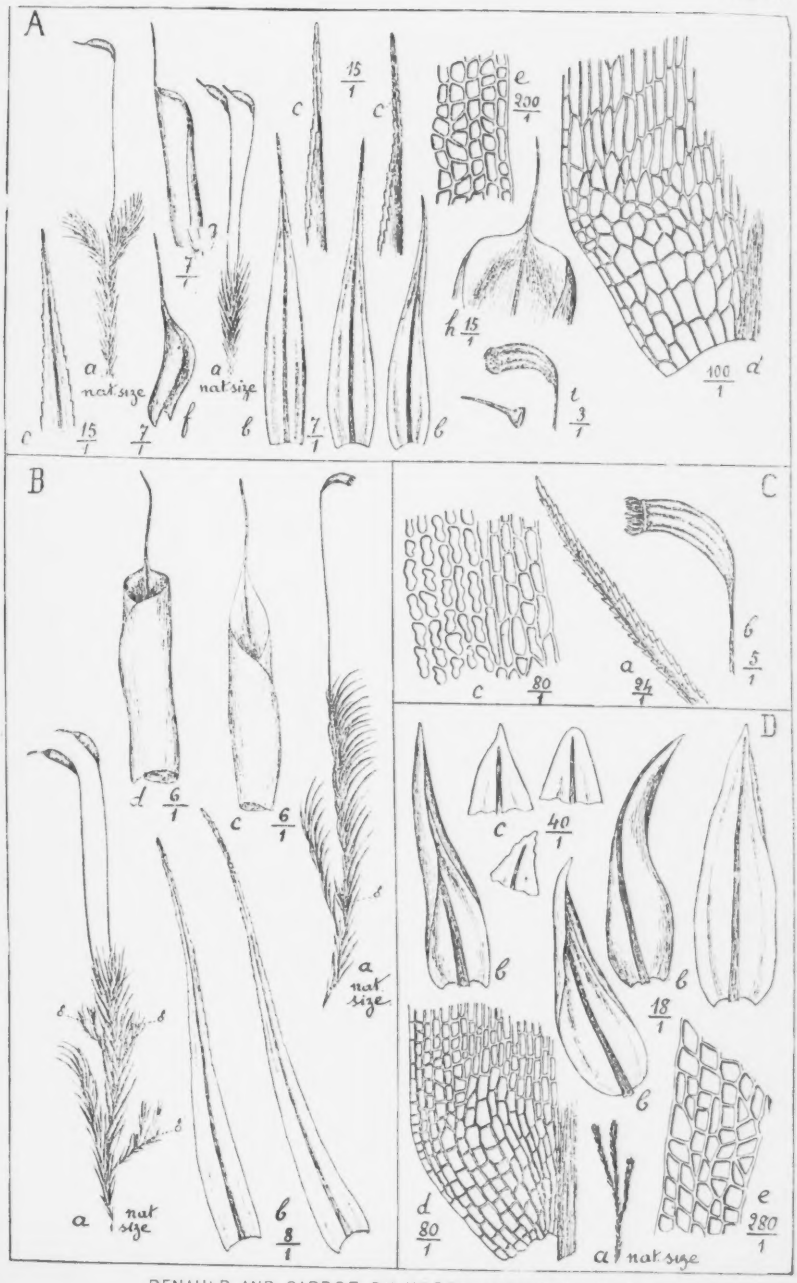
THERE HAS been recently patented in Germany by Dr. W. Koch and Max Wolz a novel arrangement for transmitting light through glass rods for the purpose of illuminating inaccessible parts of the body, such as the larynx. The same principle has been applied to the illumination of objects on the stage of the microscope. It is well known that light impinging upon the surface of glass at a less angle than 40°, suffers total reflection. The novel illuminating apparatus therefore consists of a hooded lamp, with a glass rod curved properly extending from a hole in the metal hood to the aperture in the stage. The light entering the end of the rod suffers numerous total reflections, until it reaches the end, where it emerges. The advantages for night work are sufficiently obvious and the low price (M. 15) puts it within easy reach. The apparatus is manufactured by two firms in Bonn, Marquart (C. Gerhardt), and Max Wolz.

IN THE PART OF HOOKER'S *Icones Plantarum*, just published, is a description of a gigantic ice-plant of S. Africa, whose "leaves are so juicy that it not only furnishes the cattle with moisture in that country, but is used by Europeans in traveling for the purpose of washing, and even drinking, the water squeezed out being devoid of taste." (*Gard. Chron.*, Jan. 19.)

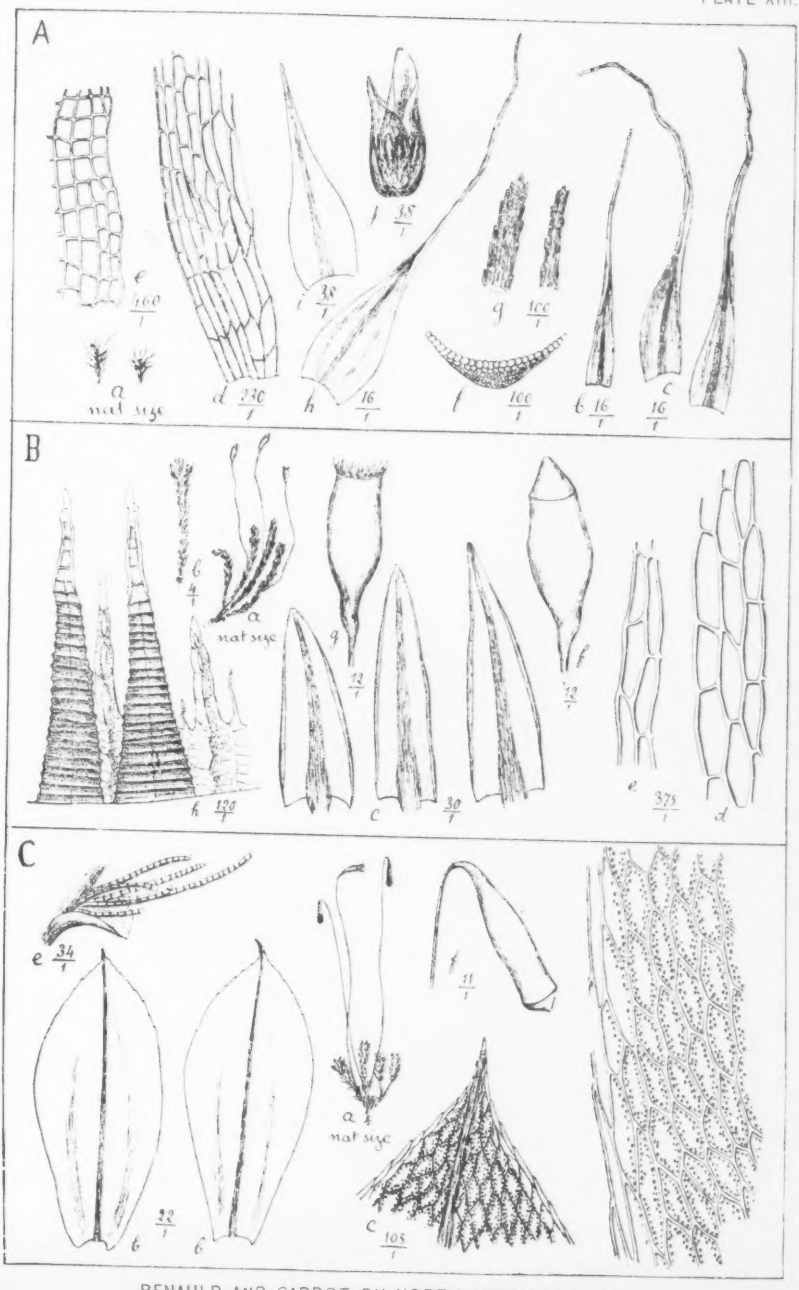
M. BUYSMAN, of Middelburg, Holland, whose preparation of analytical herbaria we have already noticed (BOT. GAZETTE, xiii. 326), in a private letter calls attention to a change in the mode of preparation by his collaborators. The necessary fragments and flowers are not to be sent in bottles, as previously mentioned, but in tin boxes thoroughly moistened with alcohol. This change has been suggested by Dr. Schweinfurth. The tin boxes, and alcohol if necessary, will be furnished by M. Buysman to all who desire to help him. Only the colored flowers he wants dried and spread out. The aid of American botanists is asked in supplying the medicinal and useful plants (cultivated or not) of this country. All necessary expenses are to be paid by M. Buysman, to whom application may be made for fuller information.

BOKORNY has recently confirmed to some extent Bäyer's theory of assimilation, viz.: that green plants in light reduce CO_2, CO remaining loosely combined with the chlorophyll, and from this some simple substance (such as formic aldehyde, CH_2O) is first formed, which is subsequently converted into a carbohydrate. Experimenting with Spirogyra, he excluded CO_2 and furnished instead formic aldehyde, methylal, methyl alcohol, glycol, or glycerin. Formic aldehyde proved poisonous, but from all the other substances the plants were able to manufacture starch and increase their dry weight. That they are able to convert these substances into a carbohydrate is not demonstrative evidence that they actually form these substances in the course of manufacture of carbohydrates from CO_2, but it increases the probability that they do.

WIESNER, in a preliminary paper in the Bot. Zeitung (1889, nos. 1, 2), undertakes to show that the older parts of plants by their transpiration draw on the water supply of the younger and that this affects greatly the development of these parts. The water so sucked away from the upper parts he speaks of as "the descending water stream." In general the buds, axillary and terminal, as well as the shoots arising therefrom, are hindered more or less completely in their development by rapid transpiration and accelerated by slower. By thus affecting the development of growing points, it is the transpiration and not the innate constitution of the plant which determines the production of sympodial shoots, or of false dichotomy. This his experimental evidence seems to confirm, since he was able to cause the abortion or development of the terminal bud by regulating the transpiration. The effect of transpiration is of course not direct. It acts by altering the turgor of the cells, the plasticity of the cell-wall, and possibly the structure of the protoplasm in the growing points.



RENAULD AND CARDOT ON NORTH AMERICAN MOSSES



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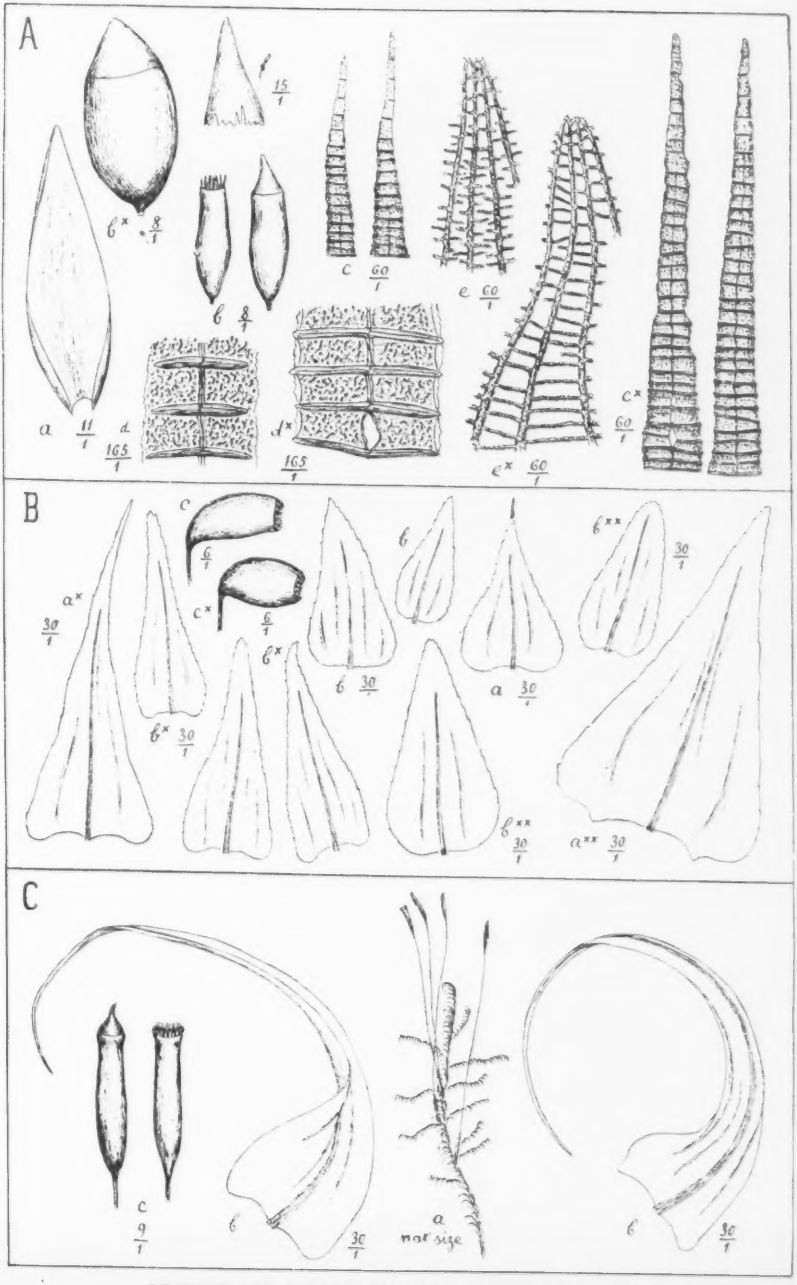

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